KODEKLOUD

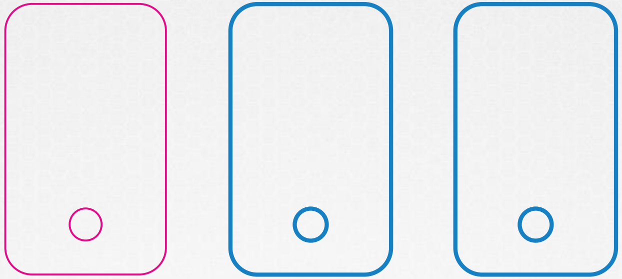
Course Objectives

- Core Concepts
- Scheduling
- Logging Monitoring
- Application Lifecycle Management
- Cluster Maintenance
- Security
  - ○ Kubernetes Security Primitives
  - ○ Authentication
  - ○ TLS Certificates for Cluster Components
  - ○ Secure Persistent Key Value Store
  - ○ Authorization
  - ○ Images Securely
  - ○ Security Contexts
  - ○ Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

I

SECURITY PRIMITIVES

Secure Hosts



- ❑ Password based authentication disabled
- ❑ SSH Key based authentication

Secure Kubernetes

kube-apiserver

Who can access?

What can they do?

Authentication

Who can access?

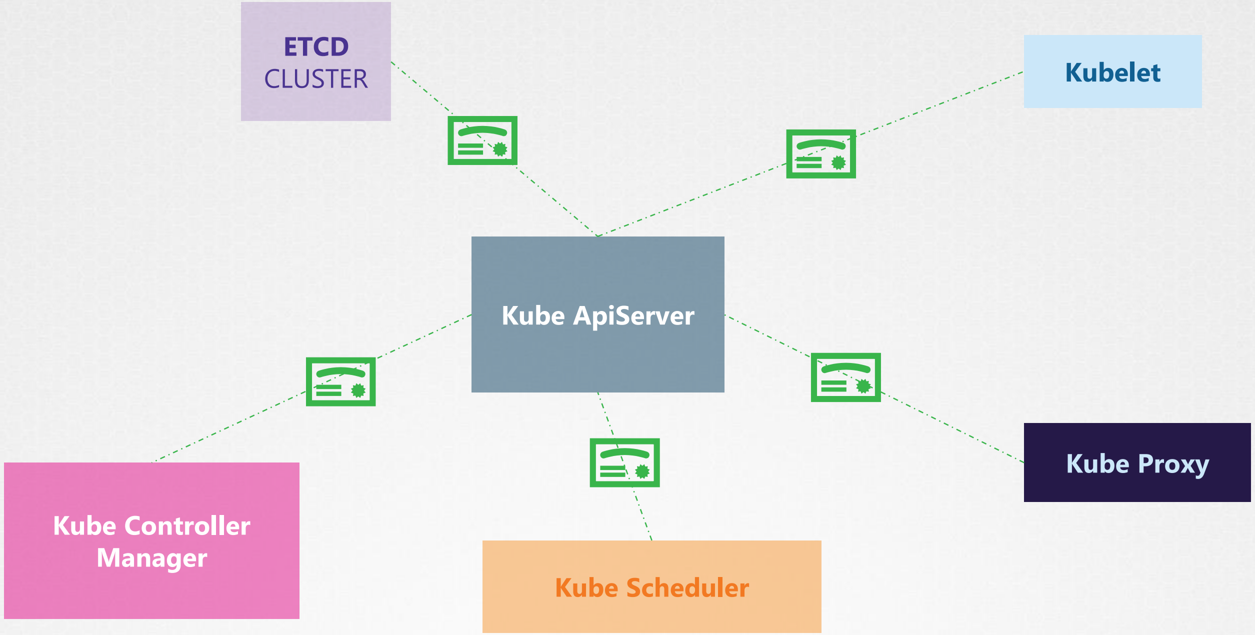
- ❑ Files – Username and Passwords
- ❑ Files – Username and Tokens
- ❑ Certificates
- ❑ External Authentication providers - LDAP
- ❑ Service Accounts

Authorization

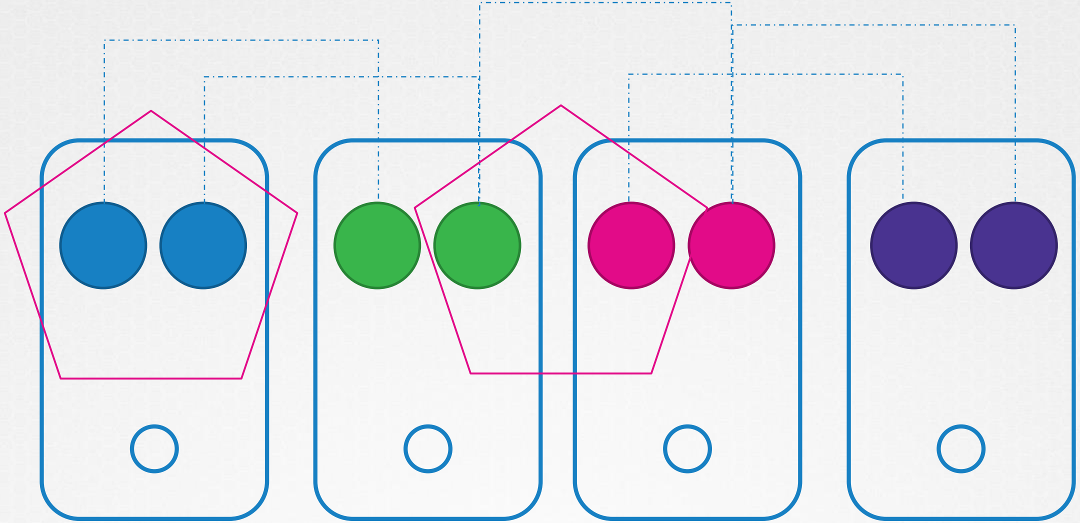
What can they do?

- ❑ RBAC Authorization
- ❑ ABAC Authorization
- ❑ Node Authorization
- ❑ Webhook Mode

TLS Certificates



Network Policies



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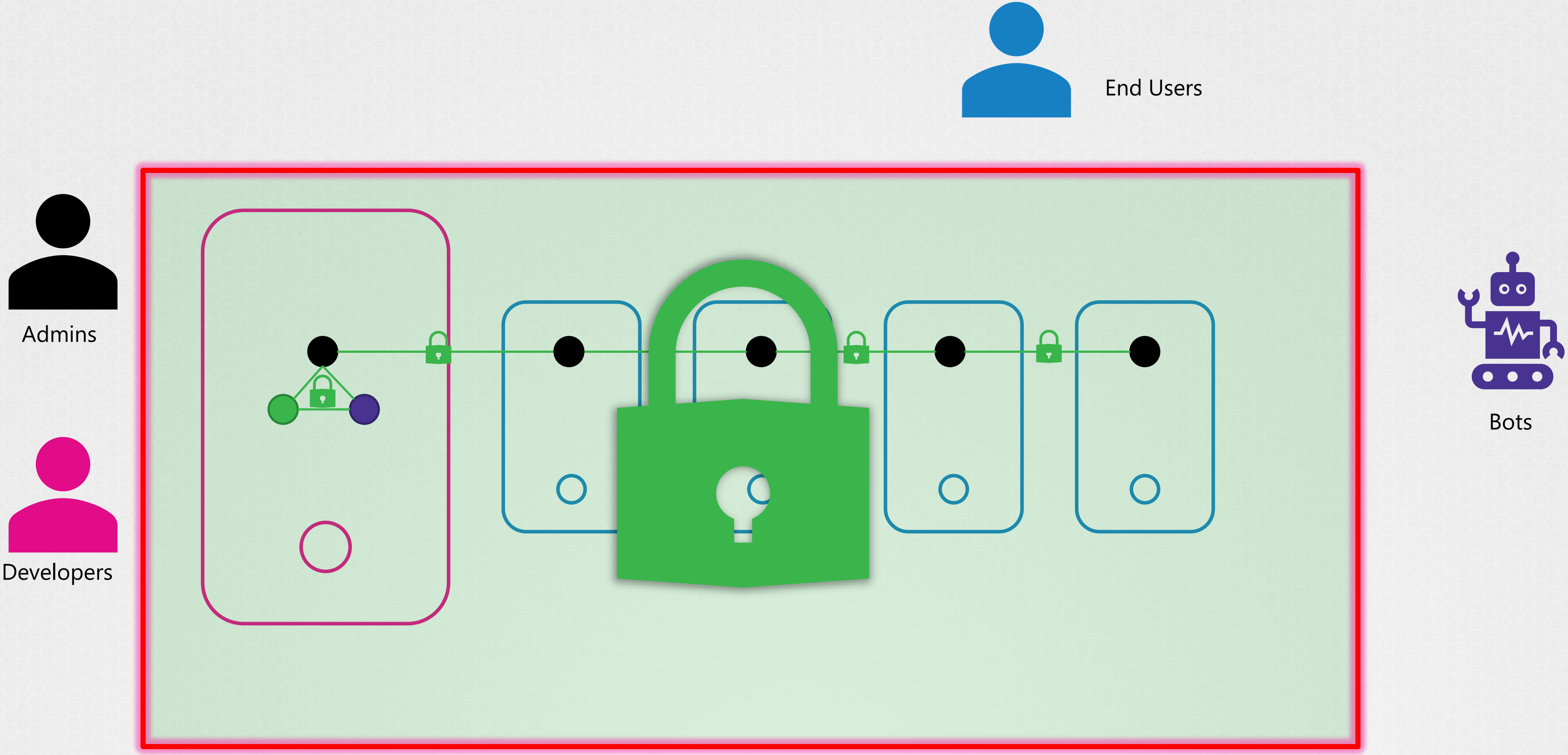
AUTHENTICATION


End Users
Admins
Developers
Bots

Accounts

Admins

Developers

Bots

User

Service Accounts

Accounts

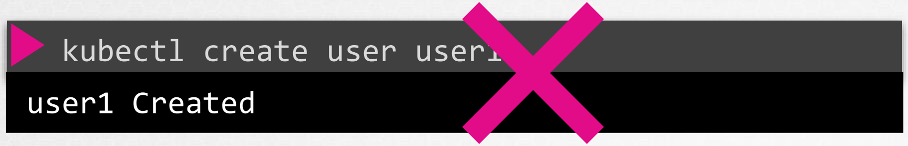
Admins

Developers

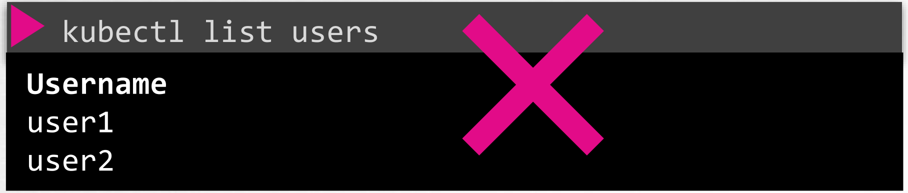
Bots

User

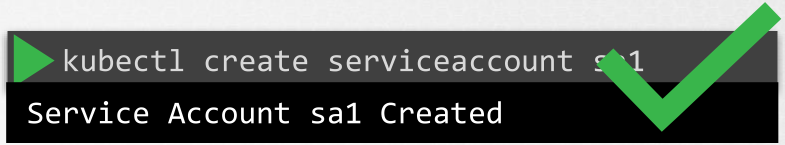
Service Accounts



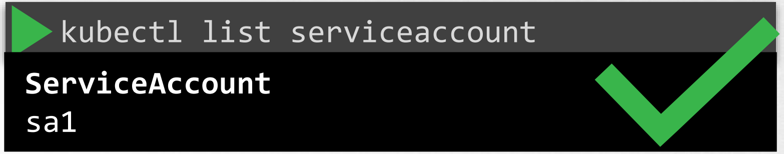
```
▶ kubectl create user user1
user1 Created
```



```
▶ kubectl list users
Username
user1
user2
```

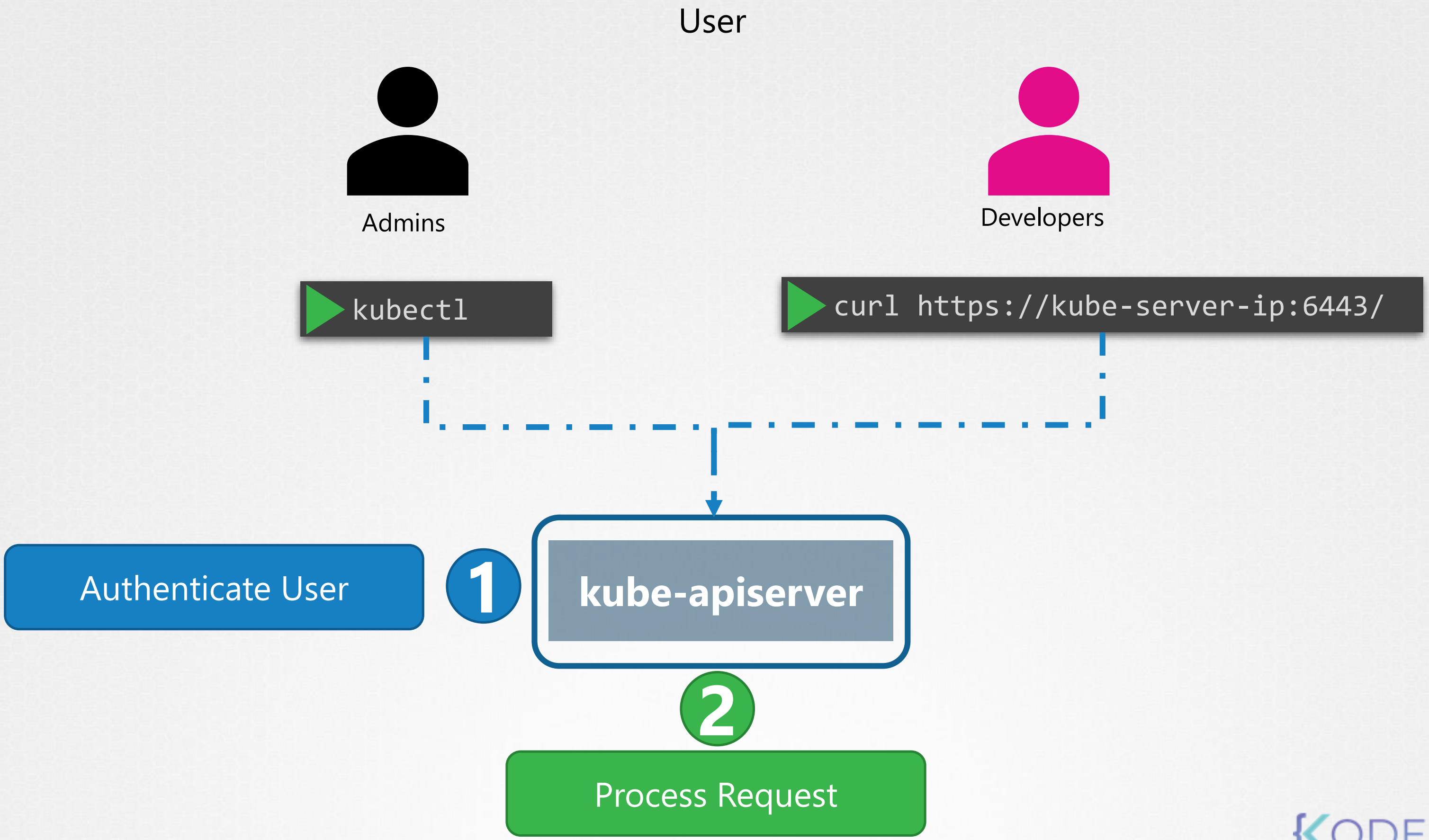


```
▶ kubectl create serviceaccount sa1
Service Account sa1 Created
```

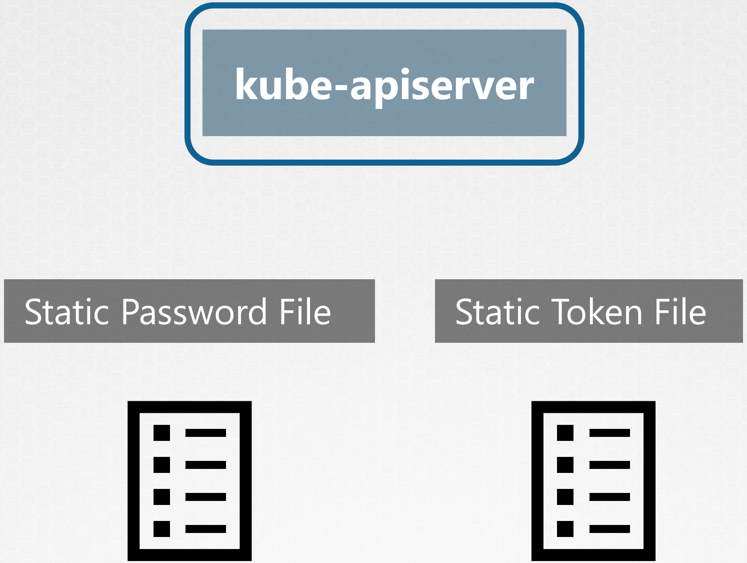


```
▶ kubectl list serviceaccount
ServiceAccount
sa1
```

Accounts


User
Admins
Developers
kubectl
curl https://kube-server-ip:6443/
Authenticate User
1
kube-apiserver
2
Process Request

Auth Mechanisms



kube-apiserver

Static Password File

Static Token File

Auth Mechanisms - Basic

kube-apiserver

```
--basic-auth-file=user-details.csv
```

--basic-auth-file=user-details.csv

user-details.csv

```
password123,user1,u0001
password123,user2,u0002
password123,user3,u0003
password123,user4,u0004
password123,user5,u0005
```

kube-apiserver.service

```
ExecStart=/usr/local/bin/kube-apiserver \\
  --advertise-address=${INTERNAL_IP} \\
  --allow-privileged=true \\
  --apiserver-count=3 \\
  --authorization-mode=Node,RBAC \\
  --bind-address=0.0.0.0 \\
  --enable-swagger-ui=true \\
  --etcd-servers=https://127.0.0.1:2379 \\
  --event-ttl=1h \\
  --runtime-config=api/all \\
  --service-cluster-ip-range=10.32.0.0/24 \\
  --service-node-port-range=30000-32767 \\
  --v=2
```

Note: Showing fewer options for simplicity

Kube-api Server Configuration

kube-apiserver.service

```
ExecStart=/usr/local/bin/kube-apiserver \\
  --advertise-address=${INTERNAL_IP} \\
  --allow-privileged=true \\
  --apiserver-count=3 \\
  --authorization-mode=Node,RBAC \\
  --bind-address=0.0.0.0 \\
  --enable-swagger-ui=true \\
  --etcd-servers=https://127.0.0.1:2379 \\
  --event-ttl=1h \\
  --runtime-config=api/all \\
  --service-cluster-ip-range=10.32.0.0/24 \\
  --service-node-port-range=30000-32767 \\
  --v=2
  --basic-auth-file=user-details.csv
```

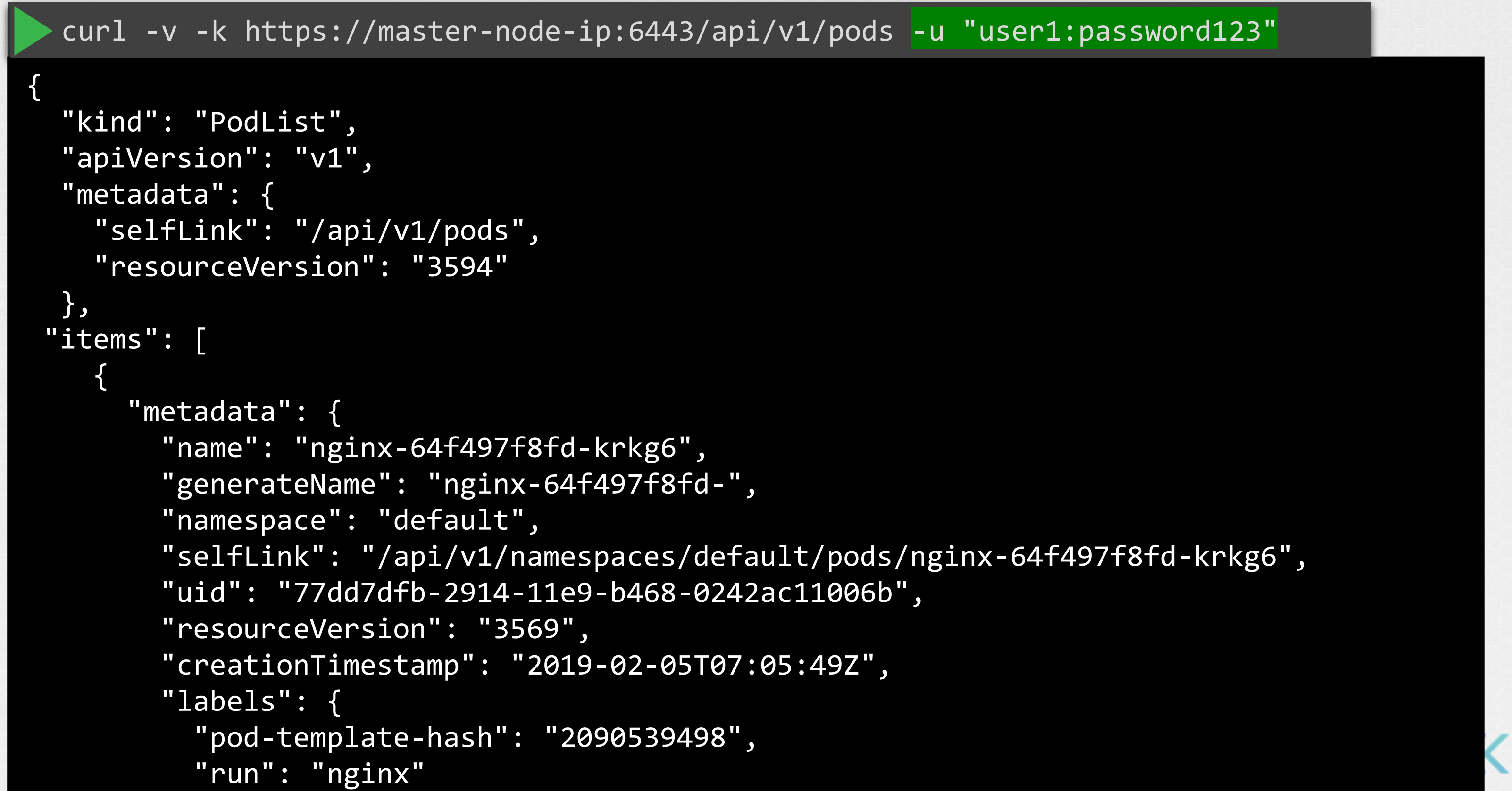
/etc/kubernetes/manifests/kube-apiserver.yaml

```
apiVersion: v1
kind: Pod
metadata:
  creationTimestamp: null
  name: kube-apiserver
  namespace: kube-system
spec:
  containers:
  - command:
    - kube-apiserver
    - --authorization-mode=Node,RBAC
    - --advertise-address=172.17.0.107
    - --allow-privileged=true
    - --enable-admission-plugins=NodeRestriction
    - --enable-bootstrap-token-auth=true

    image: k8s.gcr.io/kube-apiserver-amd64:v1.11.3
    name: kube-apiserver
```

Note: Showing fewer options for simplicity

Authenticate User



```
▶ curl -v -k https://master-node-ip:6443/api/v1/pods -u "user1:password123"
```

```
{
  "kind": "PodList",
  "apiVersion": "v1",
  "metadata": {
    "selfLink": "/api/v1/pods",
    "resourceVersion": "3594"
  },
 "items": [
    {
      "metadata": {
        "name": "nginx-64f497f8fd-krkg6",
        "generateName": "nginx-64f497f8fd-",
        "namespace": "default",
        "selfLink": "/api/v1/namespaces/default/pods/nginx-64f497f8fd-krkg6",
        "uid": "77dd7dfb-2914-11e9-b468-0242ac11006b",
        "resourceVersion": "3569",
        "creationTimestamp": "2019-02-05T07:05:49Z",
        "labels": {
          "pod-template-hash": "2090539498",
          "run": "nginx"
```

Auth Mechanisms - Basic

Static Password File

user-details.csv

```
password123,user1,u0001,group1
password123,user2,u0002,group1
password123,user3,u0003,group2
password123,user4,u0004,group2
password123,user5,u0005,group2
```

Static Token File

user-token-details.csv

```
KpjCVbI7rCFAHYPkByTIzRb7gu1cUc4B,user10,u0010,group1
rJjncHmvtXHc6MlWQddhtvNyyhgTdxSC,user11,u0011,group1
mjpOFIEiFOkL9toikaRNtt59ePtczZSq,user12,u0012,group2
PG41IXhs7QjqwWkmBkvgGT9glOyUqZij,user13,u0013,group2
```

```
--token-auth-file=user-details.csv
```

```
▶ curl -v -k https://master-node-ip:6443/api/v1/pods --header "Authorization: Bearer KpjCVbI7rCFAHYPkBzRb7gu1cUc4B"
```

Note: Showing fewer options for simplicity

KODEKLOUD

Note

- This is not a recommended authentication mechanism
- Consider volume mount while providing the auth file in a kubeadm setup
- Setup Role Based Authorization for the new users

KODEKLOUD

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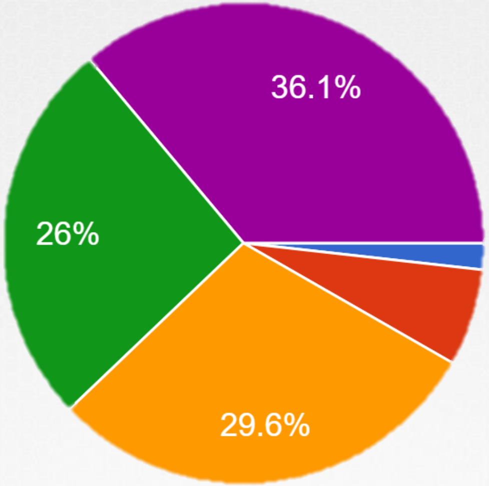


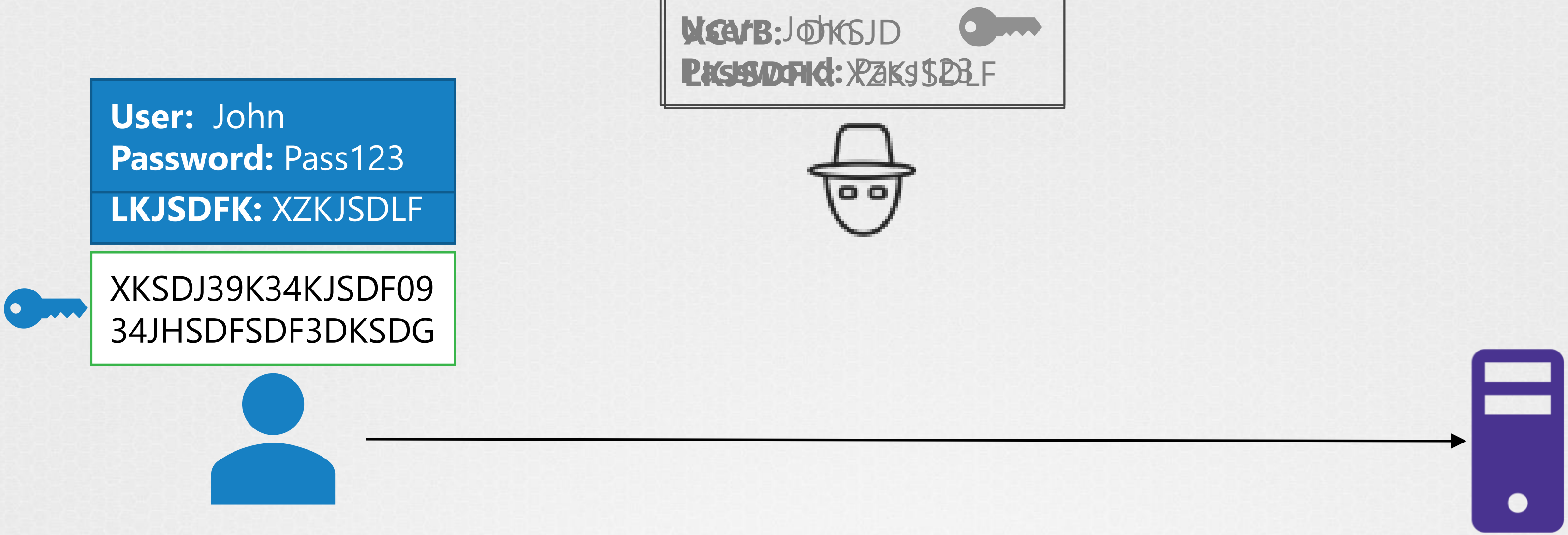
No Clue

Not very Comfortable

Goals!

- ❑ What are TLS Certificates?
- ❑ How does Kubernetes use Certificates?
- ❑ How to generate them?
- ❑ How to configure them?
- ❑ How to view them?
- ❑ How to troubleshoot issues related to Certificates

TLS CERTIFICATES (PRE-REQ)



XCVB: DKSJD
LKJSDFK: XZKJSDLF

User: John
Password: Pass123

User: John
Password: Pass123

LKJSDFK: XZKJSDLF

XKSDJ39K34KJSDF09
34JHSDFSDF3DKSDG

http://my-bank.com

SYMMETRIC ENCRYPTION

KODEKLOUD

SYMMETRIC ENCRYPTION

ASYMMETRIC ENCRYPTION

Private Key

Public Lock

Public Key

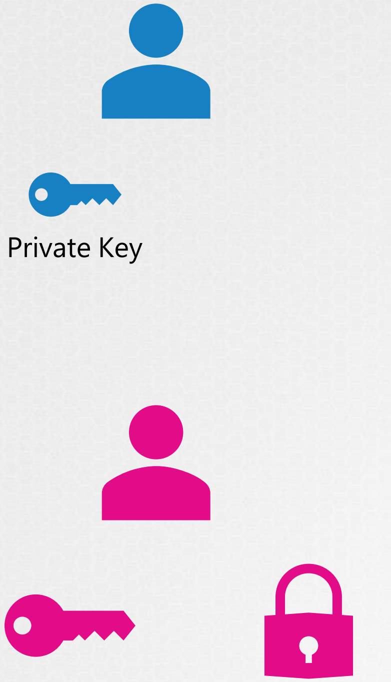
ASYMMETRIC ENCRYPTION

Private Key

Public Lock

XCVB: DKSJD
LKJSDFK: XZKJSDLF

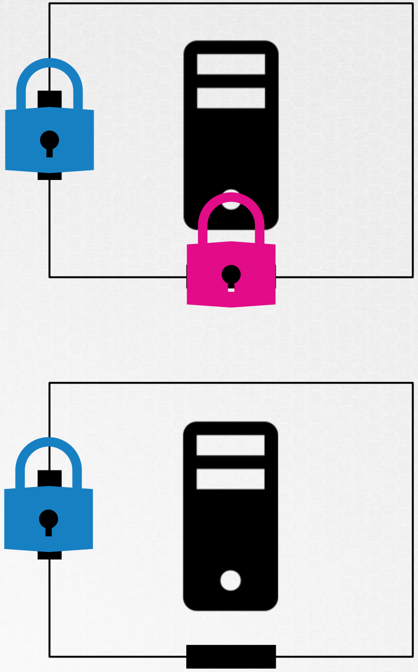
ASYMMETRIC ENCRYPTION - SSH

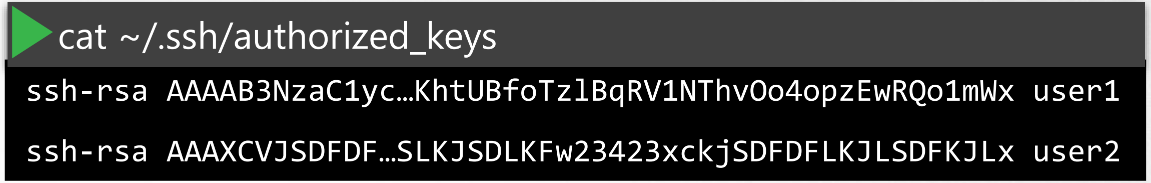


Private Key

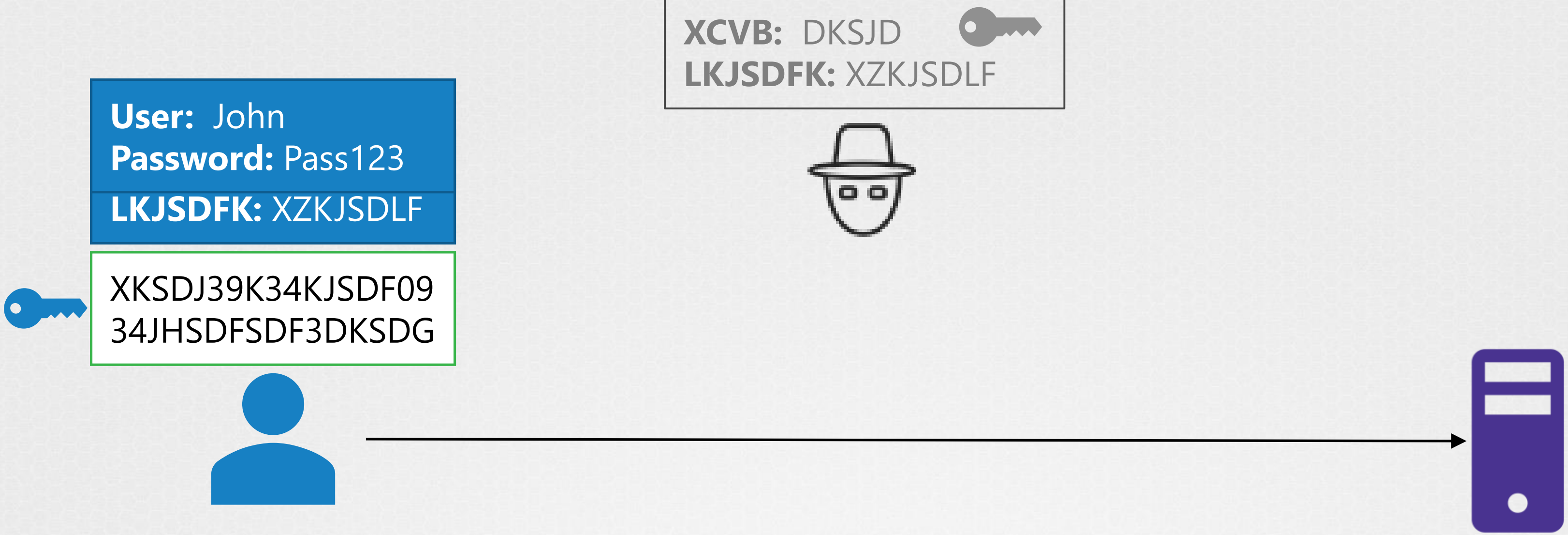
Private Key

Public Lock





```
cat ~/.ssh/authorized_keys
ssh-rsa AAAAB3NzaC1yc…KhtUBfoTzlBqRV1NThvOo4opzEwRQo1mWx user1
ssh-rsa AAAXCVJSDFDF…SLKJSDLKFw23423xckjSDFDFLKJLSDFKJLx user2
```



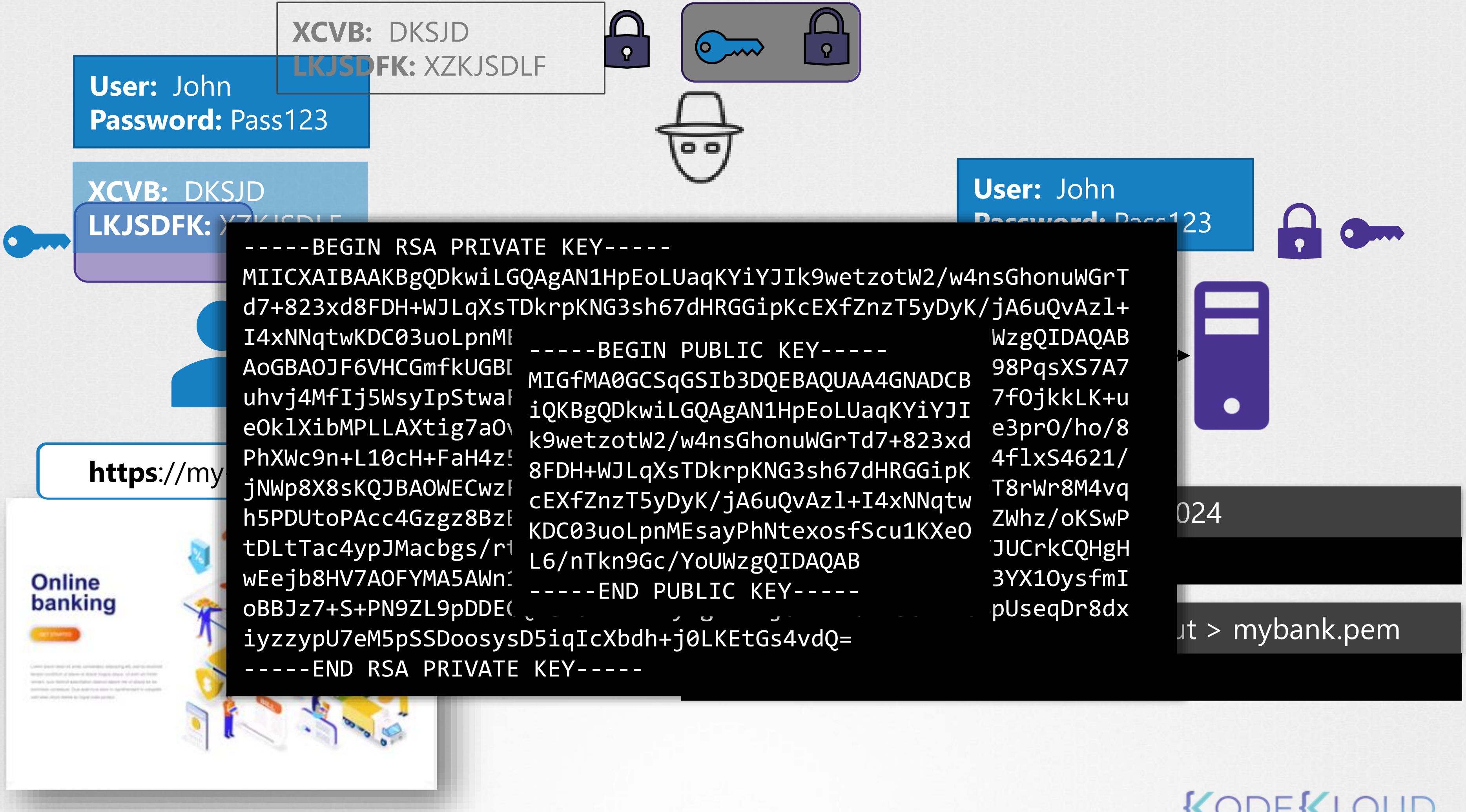
XCVB: DKSJD
LKJSDFK: XZKJSDLF

User: John
Password: Pass123
LKJSDFK: XZKJSDLF

XKSDJ39K34KJSDF09
34JHSDFSDF3DKSDG

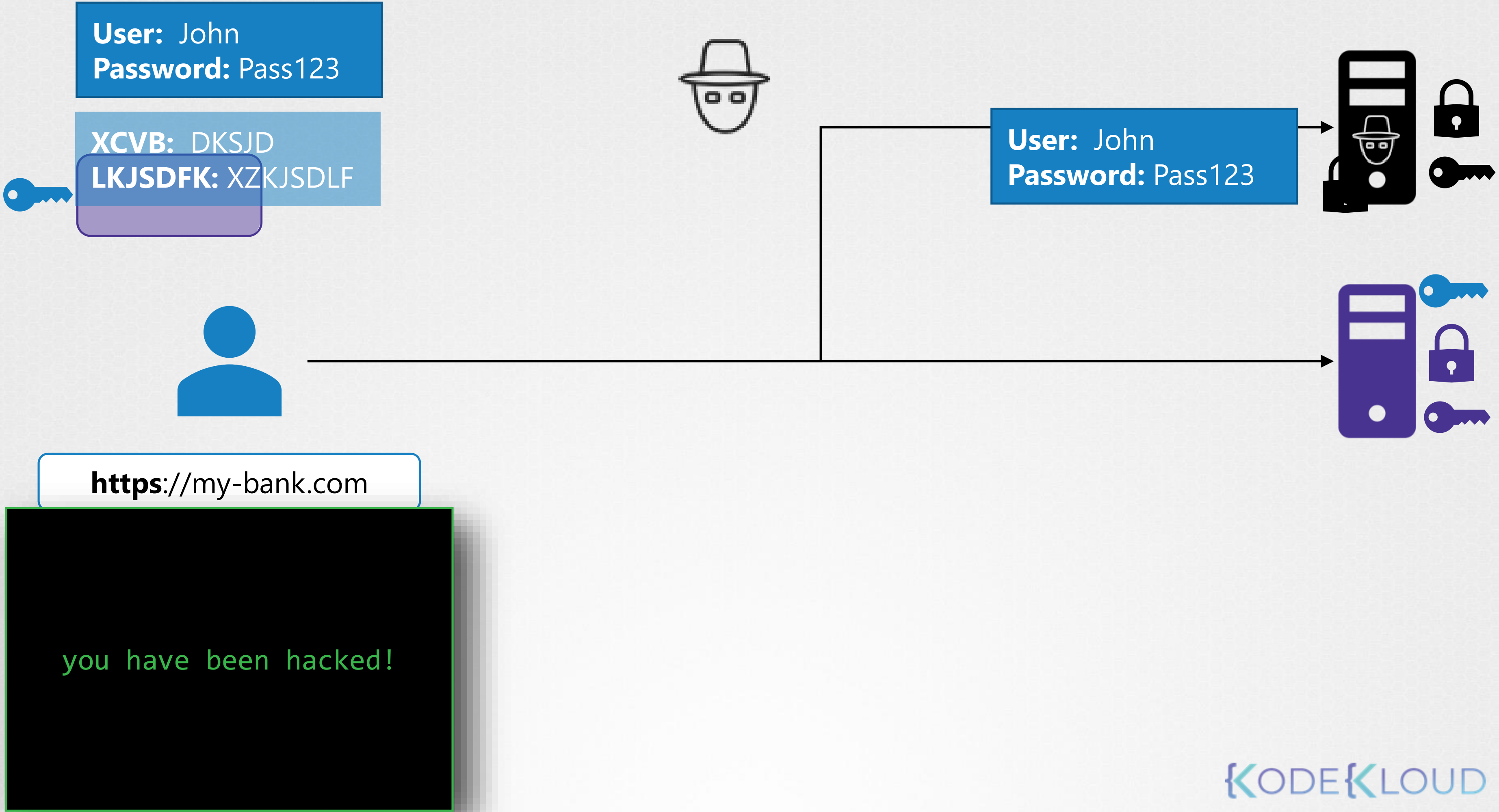
http://my-bank.com

SYMMETRIC
ENCRYPTION



```
-----BEGIN RSA PRIVATE KEY-----
MIICXAIBAAKBgQDkwiLGQAgAN1HpEoLUaqKYiYJIk9wetzotW2/w4nsGhonuWGrT
d7+823xd8FDH+WJLqXsTDkrpKNG3sh67dHRGGipKcEXfZnzT5yDyK/jA6uQvAzl+
I4xNNqtwKDC03uoLpnM                          WzgQIDAQAB
AoGBAOJF6VHCGmfkUGB                          98PqsXS7A7
uhvj4MfIj5WsyIpStwa                          7fOjkkLK+u
eOklXibMPLLAXtig7aO                          e3prO/ho/8
PhXWc9n+L10cH+FaH4z                          4flxS4621/
jNWp8X8sKQJBAOWECwz                          T8rWr8M4vq
h5PDUtoPAcc4Gzgz8Bz                          ZWhz/oKSwP
tDLtTac4ypJMacbgs/r                          JUCrkCQHgH
wEejb8HV7AOFYMA5AWn                          3YX1OysfmI
oBBJz7+S+PN9ZL9pDDE                          pUseqDr8dx
iyzzypU7eM5pSSDoosysD5iqIcXbdh+j0LKEtGs4vdQ=
-----END RSA PRIVATE KEY-----
```

```
-----BEGIN PUBLIC KEY-----
MIGfMA0GCSqGSIb3DQEBAQUAA4GNADCB
iQKBgQDkwiLGQAgAN1HpEoLUaqKYiYJI
k9wetzotW2/w4nsGhonuWGrTd7+823xd
8FDH+WJLqXsTDkrpKNG3sh67dHRGGipK
cEXfZnzT5yDyK/jA6uQvAzl+I4xNNqtw
KDC03uoLpnMEsayPhNtexosfScu1KXeO
L6/nTkn9Gc/YoUWzgQIDAQAB
-----END PUBLIC KEY-----
```



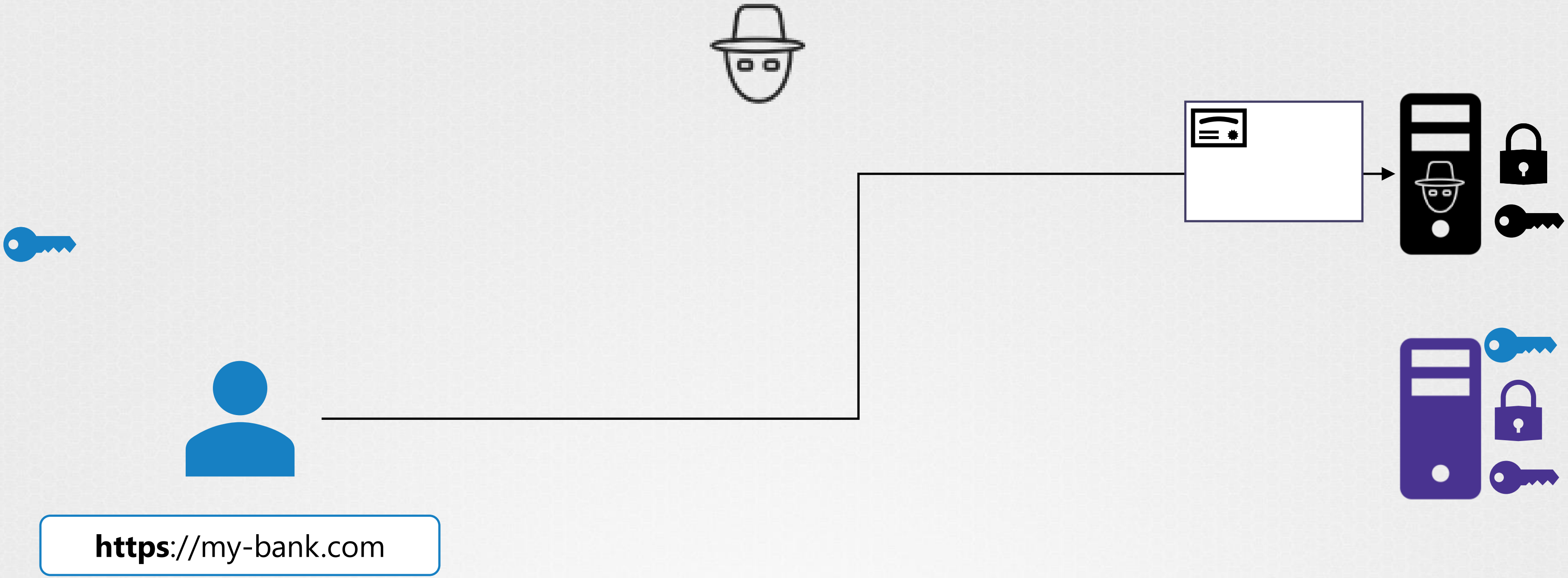
User: John
Password: Pass123

XCVB: DKSJD
LKJSDFK: XZKJSDLF

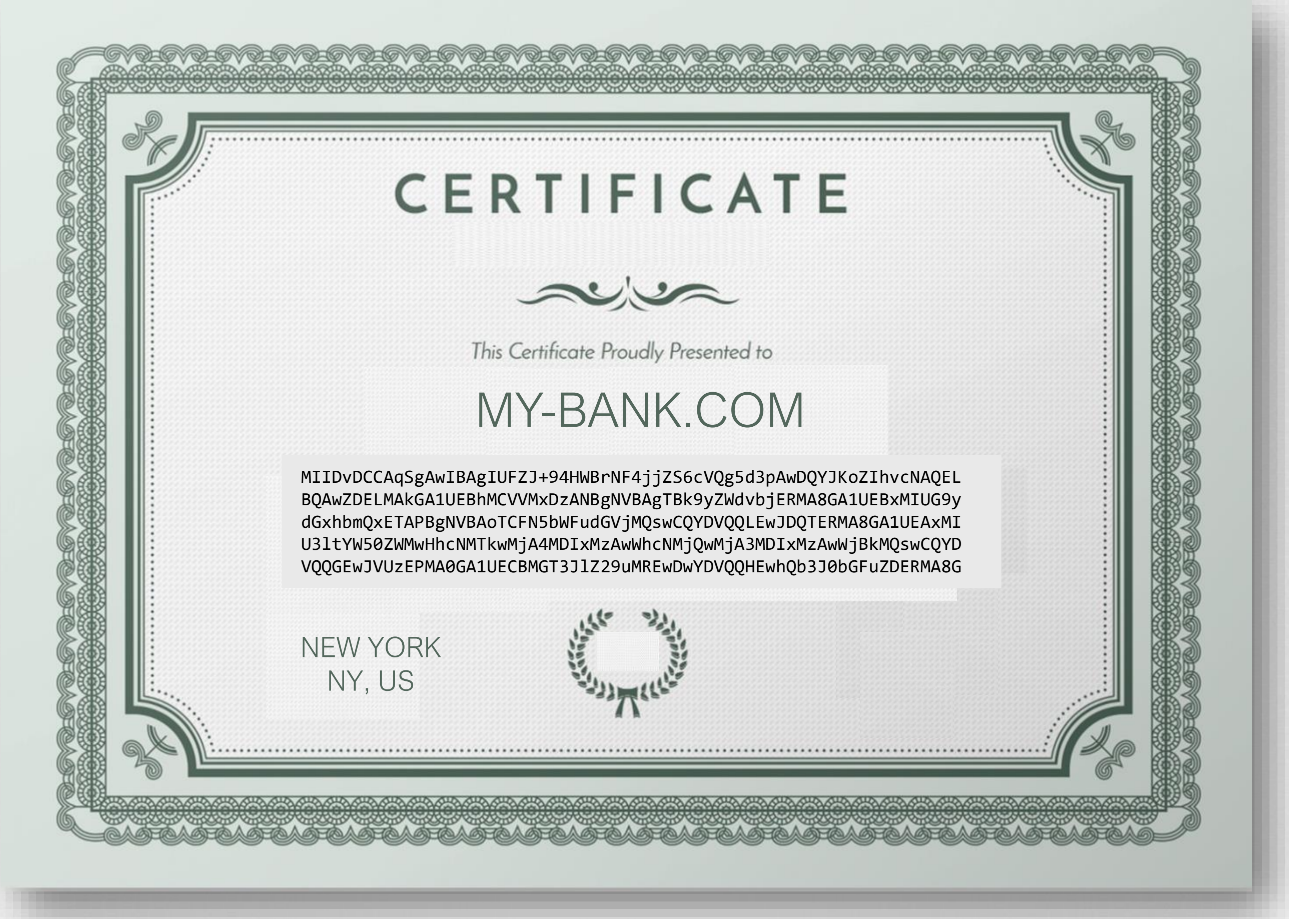
User: John
Password: Pass123

https://my-bank.com

```
you have been hacked!
```



https://my-bank.com



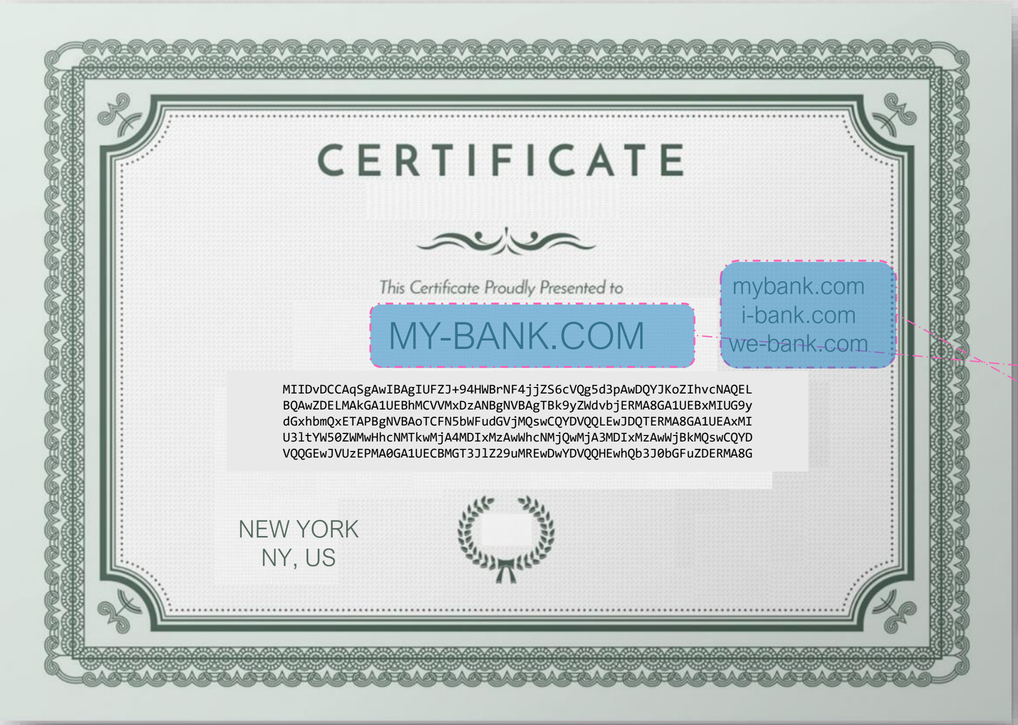
CERTIFICATE

This Certificate Proudly Presented to

MY-BANK.COM

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US



CERTIFICATE

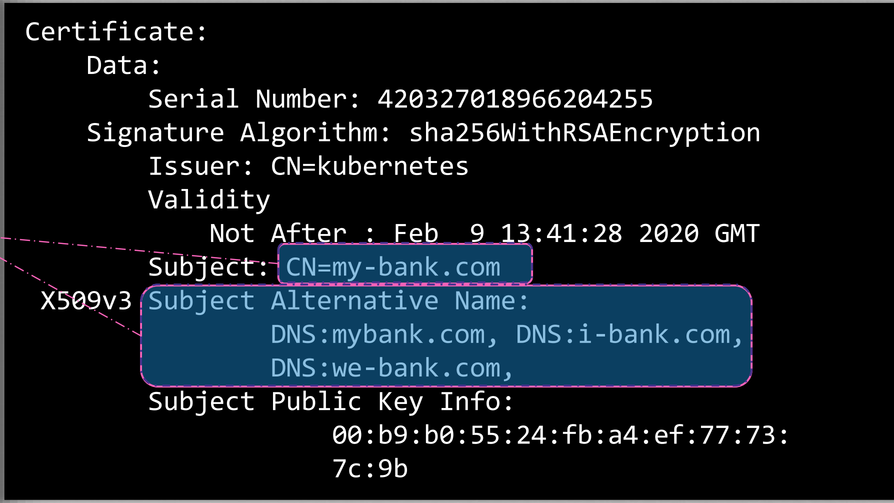
This Certificate Proudly Presented to

MY-BANK.COM

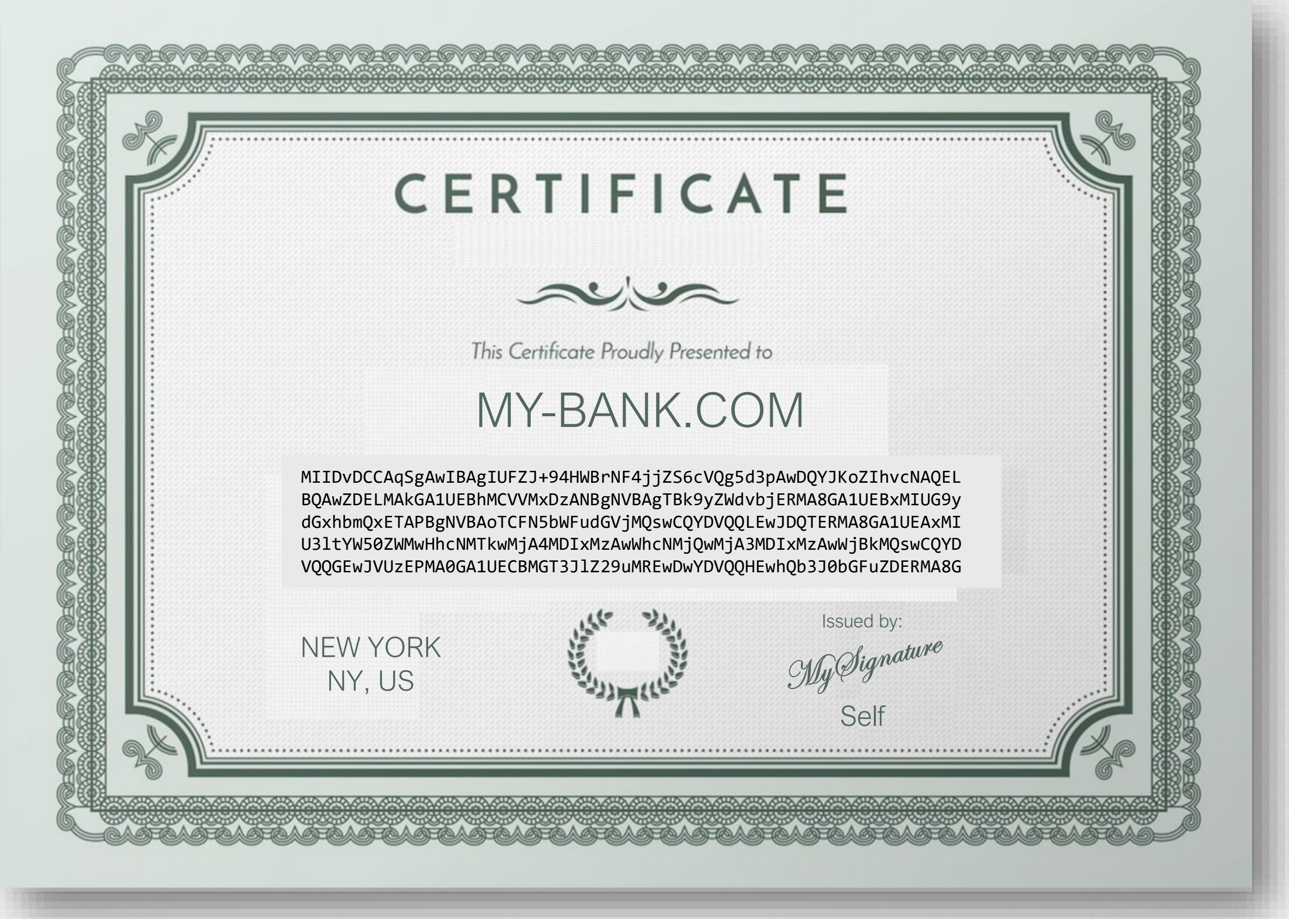
mybank.com
i-bank.com
we-bank.com

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US



```
Certificate:
    Data:
        Serial Number: 420327018966204255
    Signature Algorithm: sha256WithRSAEncryption
        Issuer: CN=kubernetes
        Validity
            Not After : Feb  9 13:41:28 2020 GMT
        Subject: CN=my-bank.com
 X509v3 Subject Alternative Name:
                DNS:mybank.com, DNS:i-bank.com,
                DNS:we-bank.com,
        Subject Public Key Info:
                    00:b9:b0:55:24:fb:a4:ef:77:73:
                    7c:9b
```



CERTIFICATE

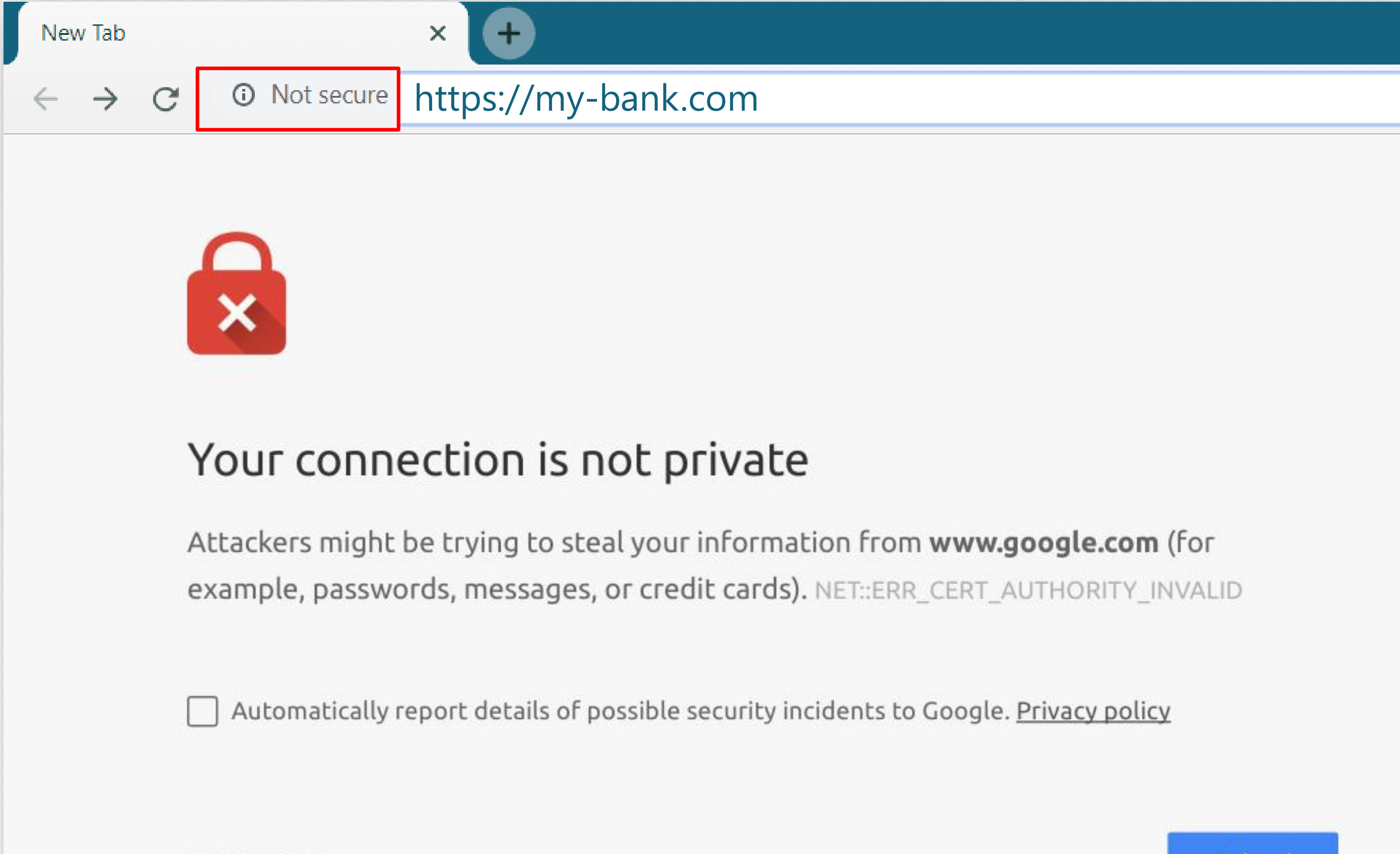
This Certificate Proudly Presented to

MY-BANK.COM

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by:
MySignature
Self



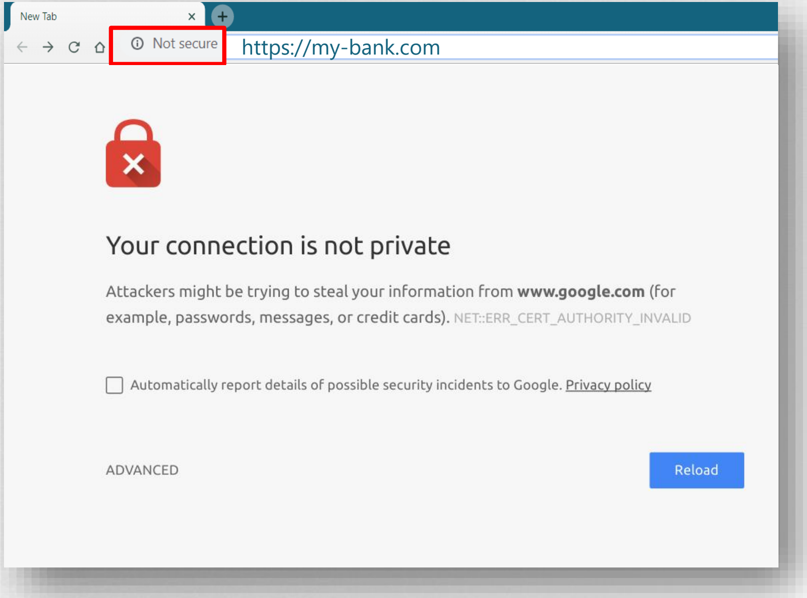
Your connection is not private

Attackers might be trying to steal your information from **www.google.com** (for example, passwords, messages, or credit cards). NET::ERR_CERT_AUTHORITY_INVALID

□ Automatically report details of possible security incidents to Google. Privacy policy

CERTIFICATE AUTHORITY (CA)

Symantec GlobalSign digicert



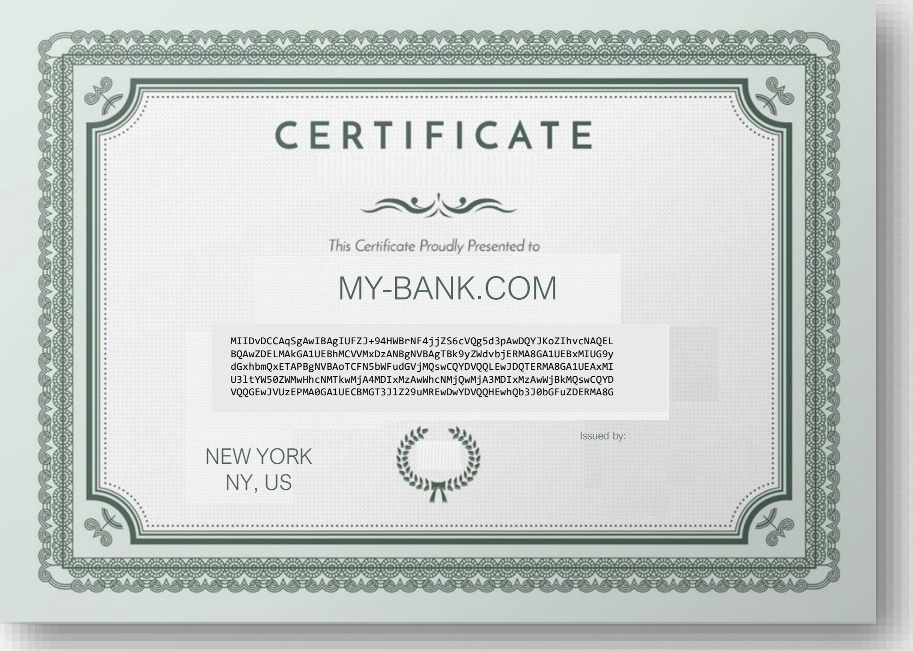
Your connection is not private

Attackers might be trying to steal your information from **www.google.com** (for example, passwords, messages, or credit cards). NET::ERR_CERT_AUTHORITY_INVALID

□ Automatically report details of possible security incidents to Google. Privacy policy

ADVANCED

Reload



CERTIFICATE

This Certificate Proudly Presented to

MY-BANK.COM

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by:

CERTIFICATE AUTHORITY (CA)

Symantec

Certificate Signing R

Validate Inforr

Sign and Send C

```
-----BEGIN CERTIFICATE REQUEST-----
MIICjDCCAXQCAQAwRzELMAkGA1UEBhMCVVMxCzAJBgNVBAgMAkNBMRQwEgYDVQQK
DAtNeU9yZywgSW5jLjEVMBMGA1UEAwwMbXlkb21haW4uY29tMIIBIjANBgkqhkiG
9w0BAQEFAAOCAQ8AMIIBCgKCAQEAp8XohAKsHxvjs+/pRKCC2Sqx7O21nuD49Kp4
WDOnDBvxEeXNviY+SuQjpTxmuVr/orIpUC7MHk/fkbIICLT4jrXrBq4MwFfcwla1
n8T0S9A7aLfWKL4rxJGFlU9DAdz4rqGLHXFIC8obLpUWJkTerHpWg++k2UDkuPJE
VQmQJ6Fe/3jWGaMNlnkY/eNyYn+a27NfMd1wQUzs9t5uFPpZbwG81mNjDvVIobA8
yHNfRDNt6gKqvZtv+vGTaMOLfgjedGne2Uq7/Bbq22rSsXgfLM9wHmSpNT57Tjs9
OQSobL4FFzoOnphhSqle1V/cGAjFlCzFIx988fH7xzduw+tRTQIDAQABoAAwDQYJ
KoZIhvcNAQELBQADggEBAByY/tTvjFp4UlUTcI2fl3TFbtYzyIwAYoB7U2sWrjzn
uEe4k2+fosUljXCJxk7EUT4sgGjVtoqJqrFihwQ1SLCViRgTwktLBDtvagViWNnQ
mDJep5YY92JxtAKZZt52wsj8MeUwTUjn6eDuz5NhpoKuiWMf9LoxGFYrgAGi2x1o
Fkse6Zr6zaB/cNdm6daW8m6qVs9hKpudTiqgD3g4MEuLLPK7VNxfFTMoSIfkLUui
OlF8dq2CW/ByrYMhUmONCAkKaag1FwY2WVm55lHY6srcwnCPhszBCri7M5BZf7OE
rgKJPfO6cAhFI7WpeuUz/Oe4Ul2r6YF+Hhk7IDKnLeI=
-----END CERTIFICATE REQUEST-----
```

.com"

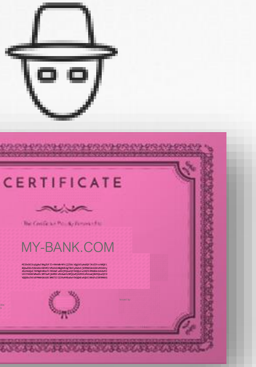
CERTIFICATE AUTHORITY (CA)

Symantec GlobalSign digicert

Certificate Signing Request (CSR)

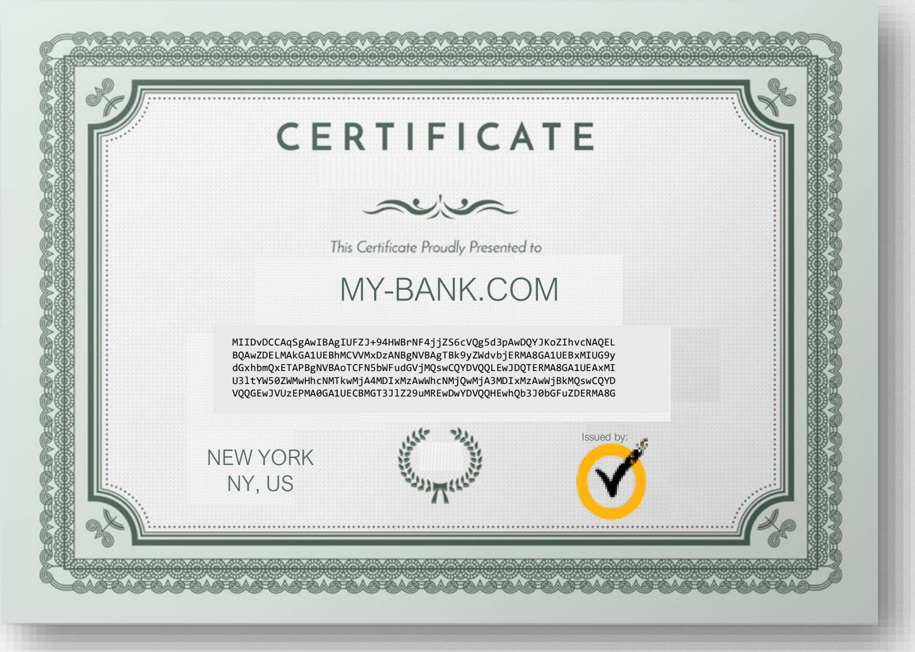
Validate Information

Sign and Send Certificate



CERTIFICATE

MY-BANK.COM



CERTIFICATE

This Certificate Proudly Presented to

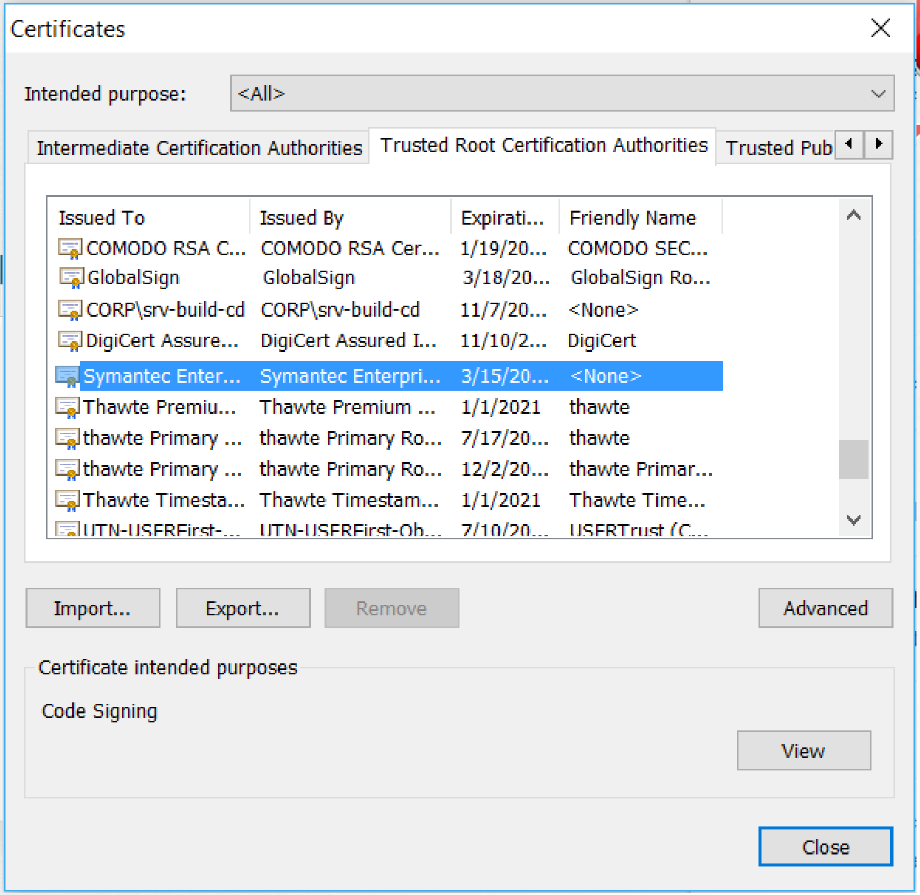
MY-BANK.COM

MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

NEW YORK
NY, US

Issued by:

CERTIFICATE AUTHORITY (CA)



Certificates

Intended purpose: <All>

Intermediate Certification Authorities
Trusted Root Certification Authorities
Trusted Pub

Issued To	Issued By	Expirati...	Friendly Name
COMODO RSA C...	COMODO RSA Cer...	1/19/20...	COMODO SEC...
GlobalSign	GlobalSign	3/18/20...	GlobalSign Ro...
CORP\srv-build-cd	CORP\srv-build-cd	11/7/20...	<None>
DigiCert Assure...	DigiCert Assured I...	11/10/2...	DigiCert
Symantec Enter...	Symantec Enterpri...	3/15/20...	<None>
Thawte Premiu...	Thawte Premium ...	1/1/2021	thawte
thawte Primary ...	thawte Primary Ro...	7/17/20...	thawte
thawte Primary ...	thawte Primary Ro...	12/2/20...	thawte Primar...
Thawte Timesta...	Thawte Timestam...	1/1/2021	Thawte Time...
UTN-USERFirst-...	UTN-USERFirst-Oh...	7/10/20...	USERTrust (C...

Certificate intended purposes

Code Signing

CERTIFICATE

This Certificate Proudly Presented to

MY-BANK.COM

MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

NEW YORK
NY, US

Issued by:

CERTIFICATE AUTHORITY (CA)

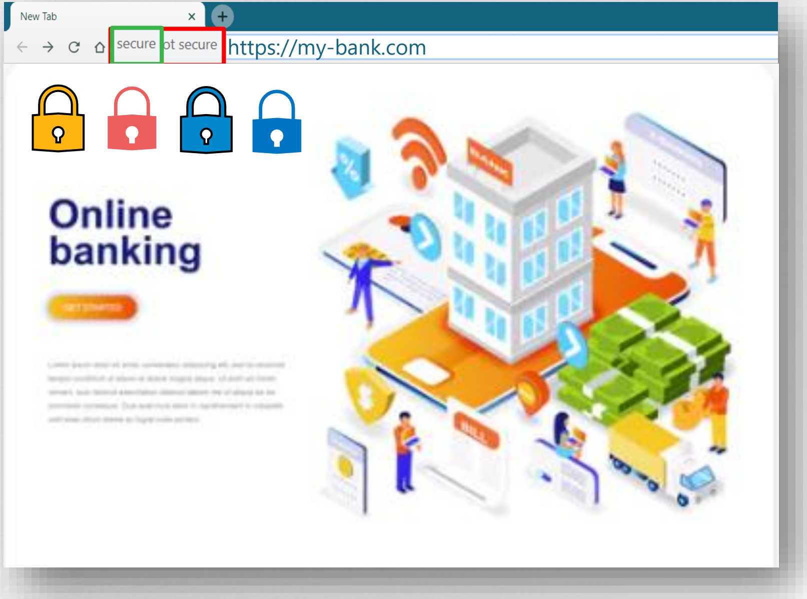
Symantec

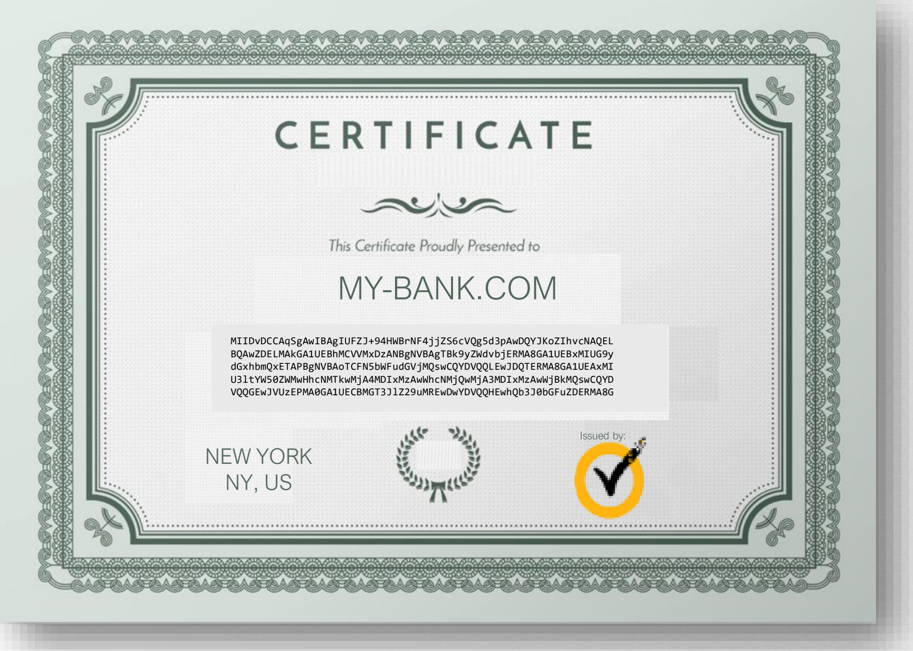
GlobalSign

digicert

Symantec

Private CA





CERTIFICATE

This Certificate Proudly Presented to

MY-BANK.COM

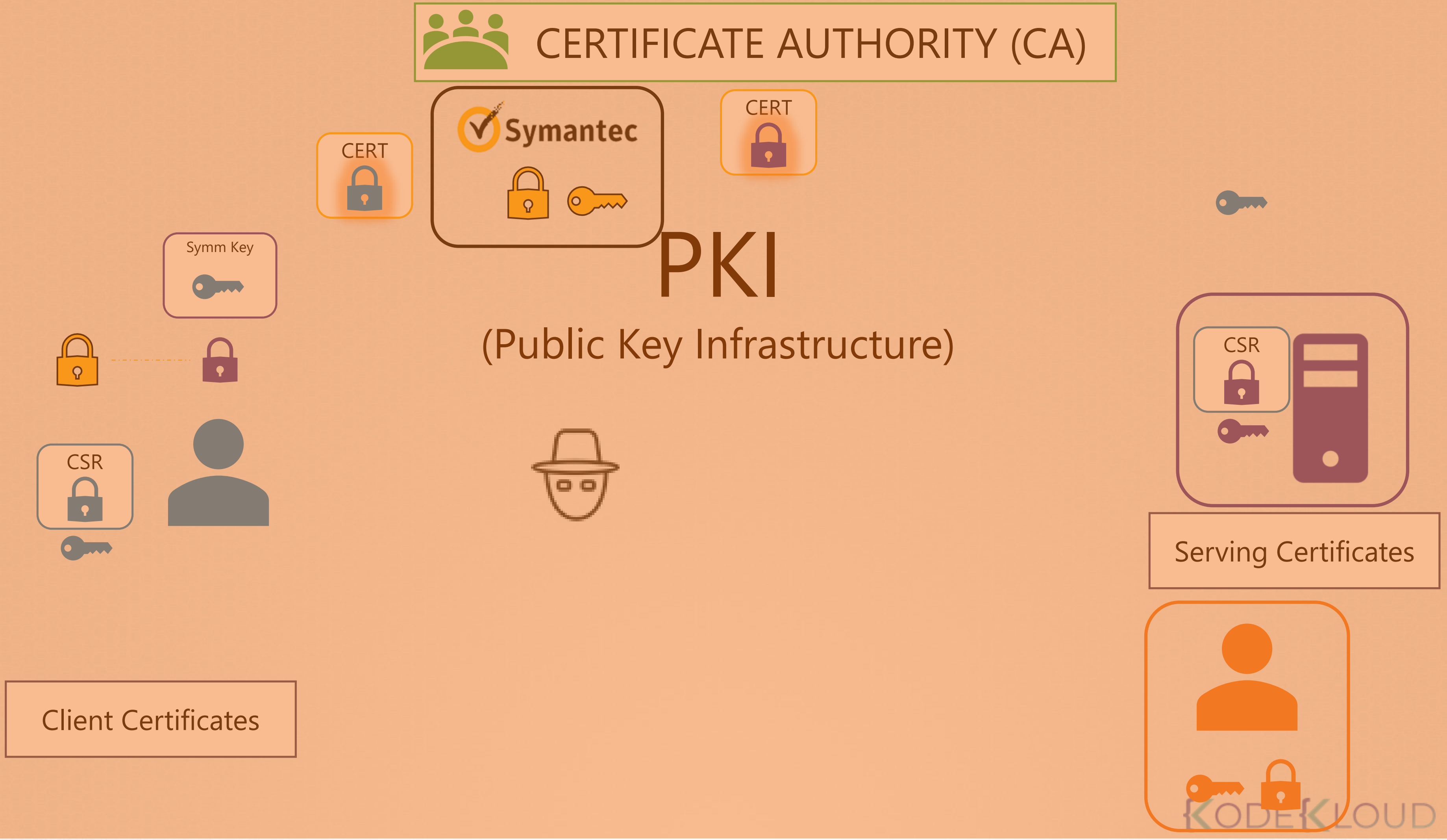
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

NEW YORK
NY, US

Issued by:

PKI

(Public Key Infrastructure)



CERTIFICATE AUTHORITY (CA)

Symantec

CERT

CERT

Symm Key

CSR

CSR

Serving Certificates

Client Certificates

Certificate (Public Key)

----

*.crt *.pem

server.crt
server.pem
client.crt
client.pem

Public Key (Lock)

User: John
Password: Pass123

XCVB: DKSJD
LKJSDFK: XZKJSDLF

Private Key

----

*.key *-key.pem

server.key
server-key.pem
client.key
client-key.pem

Private Key

User: John
Password: Pass123

XCVB: DKSJD
LKJSDFK: XZKJSDLF

KODEKLOUD

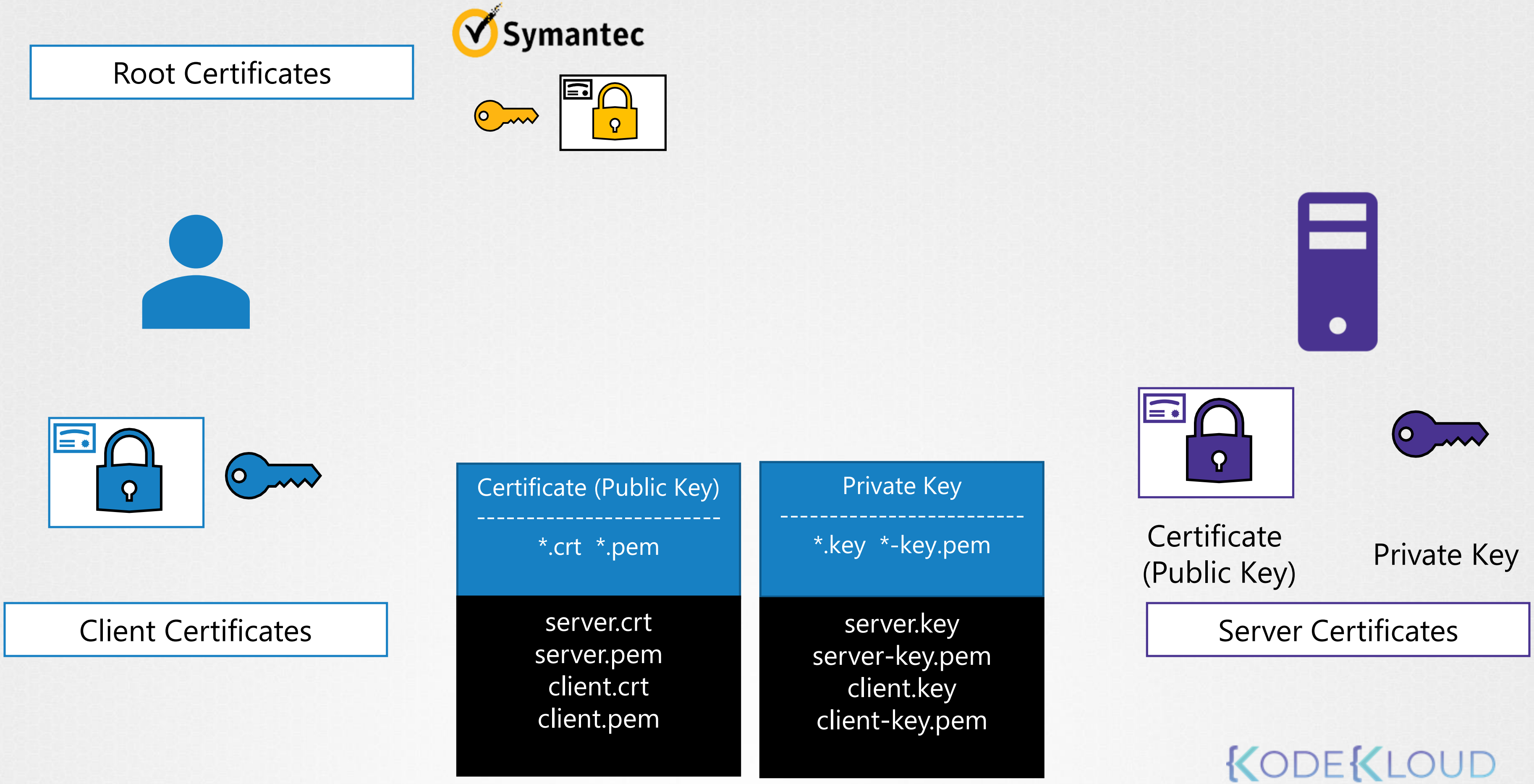
Course Objectives

- Core Concepts
- Scheduling
- Logging Monitoring
- Application Lifecycle Management
- Cluster Maintenance
- Security
  - ○ Kubernetes Security Primitives
  - ○ Secure Persistent Key Value Store
  - ○ Authentication
  - ○ Authorization
  - ○ Security Contexts
  - ○ TLS Certificates for Cluster Components
  - ○ Images Securely
  - ○ Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

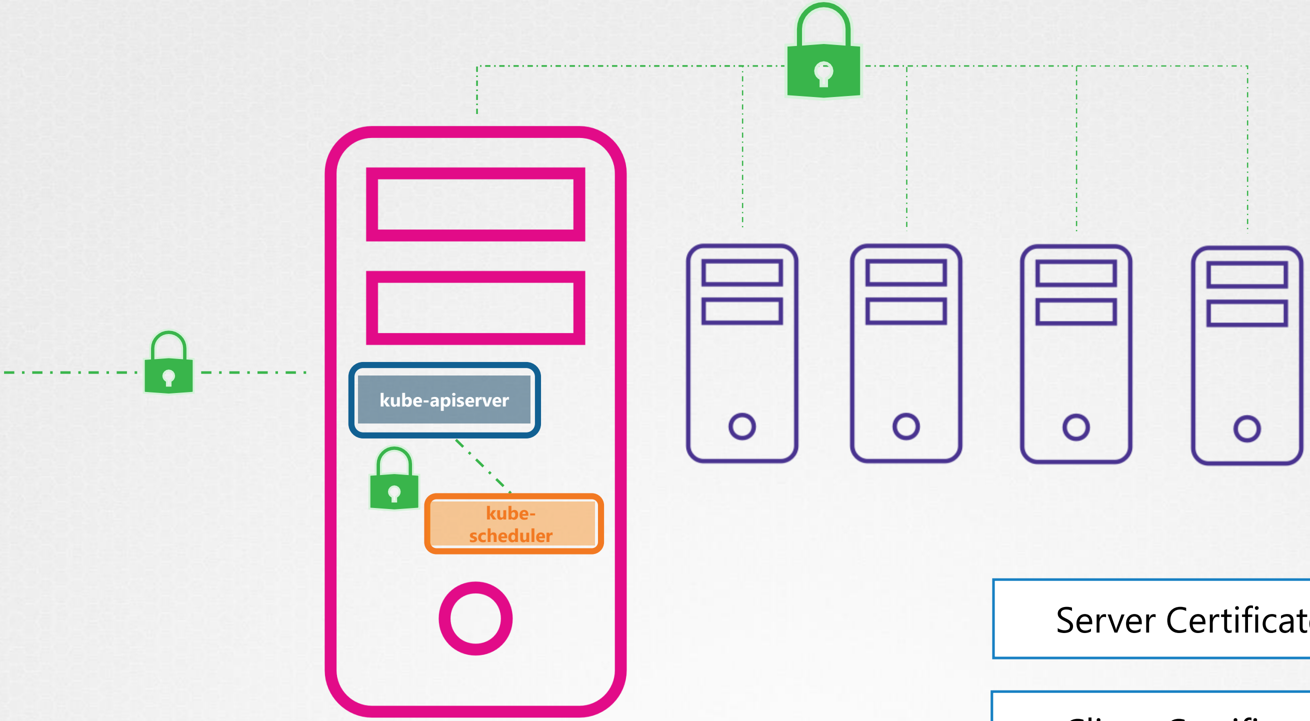
TLS CERTIFICATES

What Certificates?

CERTIFICATE AUTHORITY (CA)



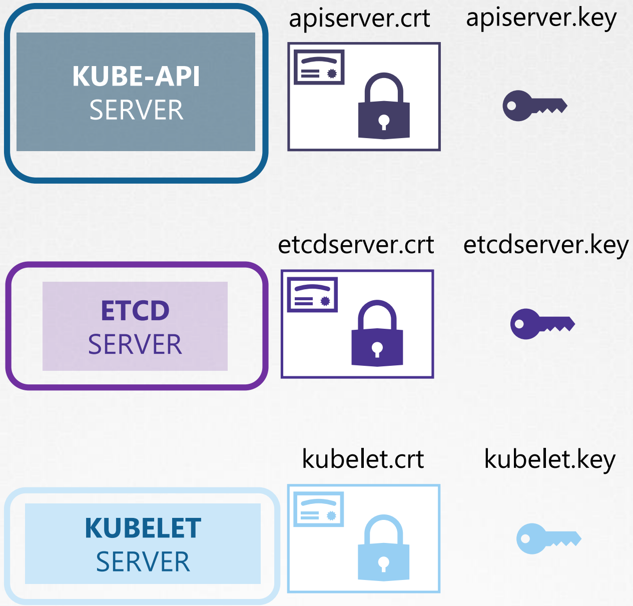
Certificate (Public Key) *.crt *.pem	Private Key *.key *-key.pem
server.crt	server.key
server.pem	server-key.pem
client.crt	client.key
client.pem	client-key.pem



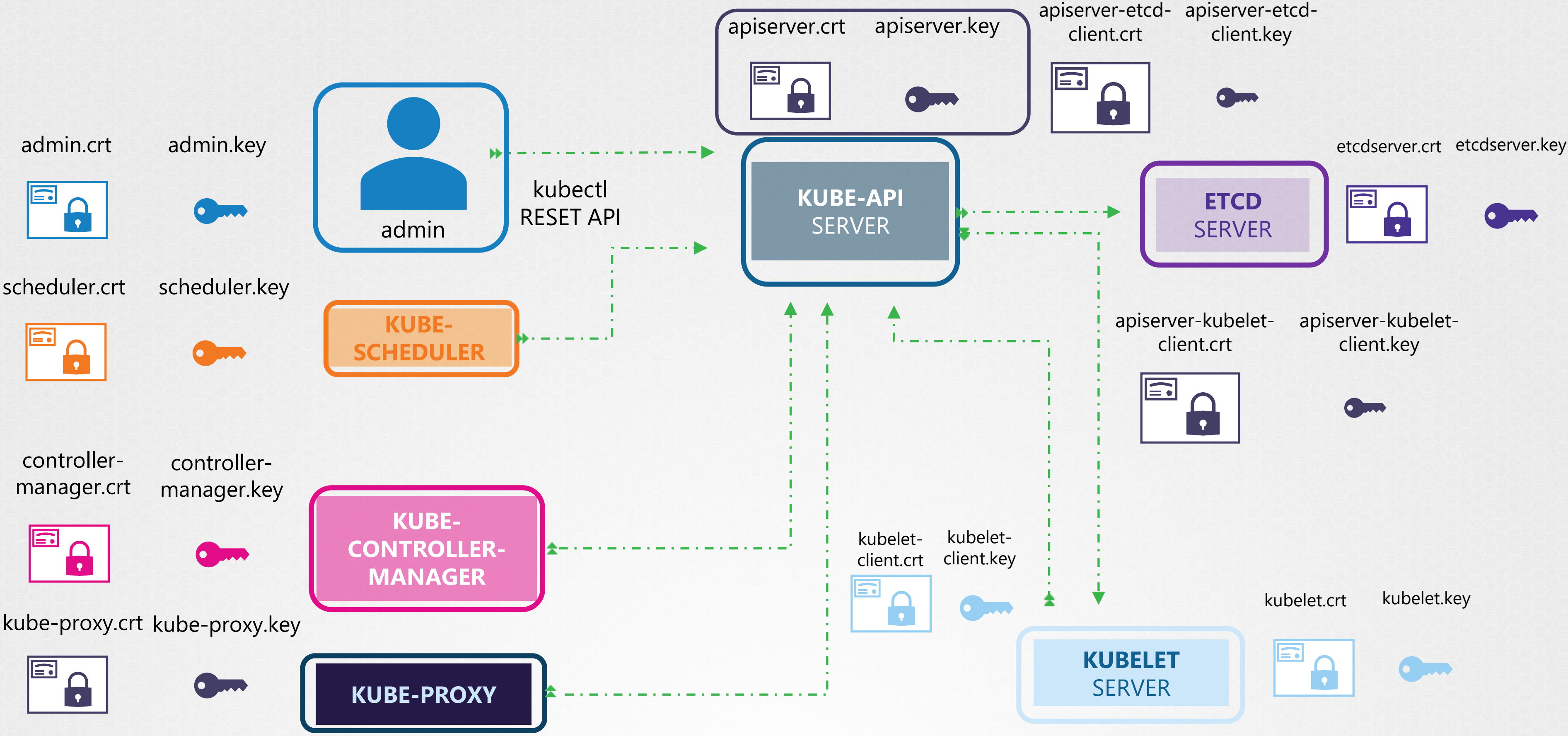
Server Certificates for Servers

Client Certificates for Clients

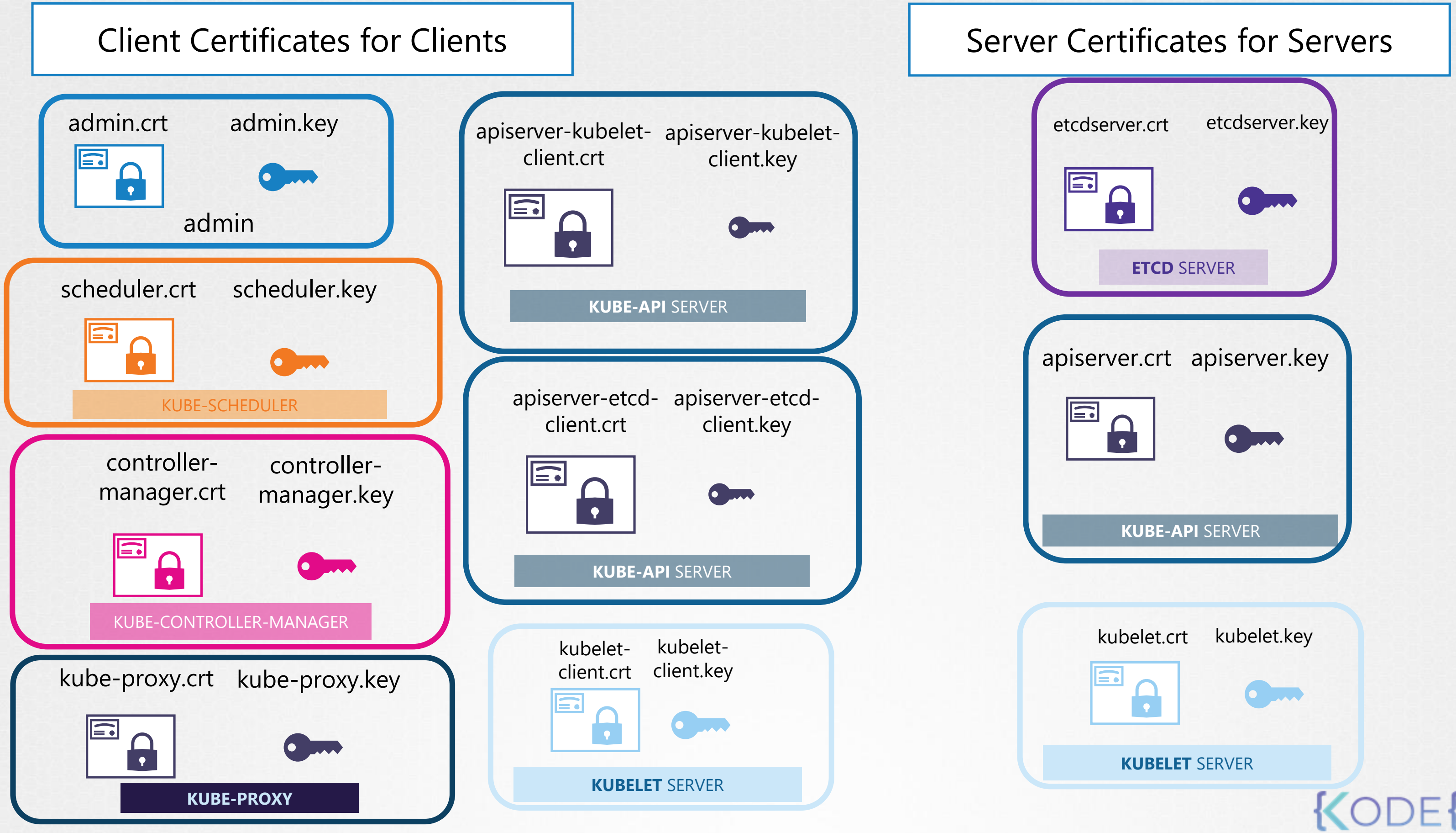
Server Certificates for Servers



Client Certificates for Clients



CERTIFICATE AUTHORITY (CA)



Client Certificates for Clients

admin.crt admin.key

admin

scheduler.crt scheduler.key

KUBE-SCHEDULER

controller-manager.crt controller-manager.key

KUBE-CONTROLLER-MANAGER

kube-proxy.crt kube-proxy.key

KUBE-PROXY

apiserver-kubelet-client.crt apiserver-kubelet-client.key

KUBE-API SERVER

apiserver-etcd-client.crt apiserver-etcd-client.key

KUBE-API SERVER

kubelet-client.crt kubelet-client.key

KUBELET SERVER

Server Certificates for Servers

etcdserver.crt etcdserver.key

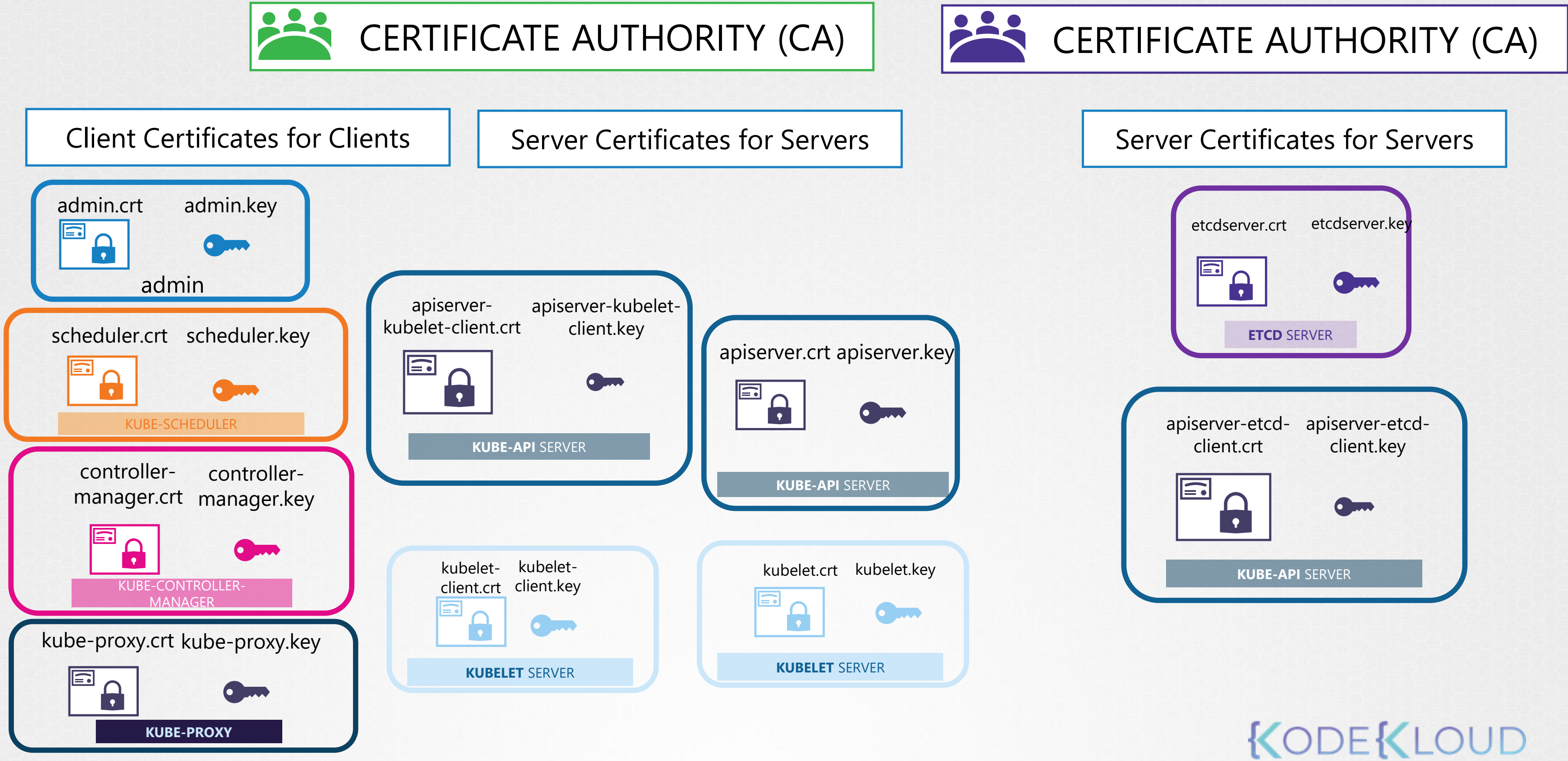
ETCD SERVER

apiserver.crt apiserver.key

KUBE-API SERVER

kubelet.crt kubelet.key

KUBELET SERVER



CERTIFICATE AUTHORITY (CA)

CERTIFICATE AUTHORITY (CA)

Client Certificates for Clients

Server Certificates for Servers

Server Certificates for Servers

admin.crt admin.key

admin

scheduler.crt scheduler.key

KUBE-SCHEDULER

controller-manager.crt controller-manager.key

KUBE-CONTROLLER-MANAGER

kube-proxy.crt kube-proxy.key

KUBE-PROXY

apiserver-kubelet-client.crt apiserver-kubelet-client.key

KUBE-API SERVER

apiserver.crt apiserver.key

KUBE-API SERVER

kubelet-client.crt kubelet-client.key

KUBELET SERVER

kubelet.crt kubelet.key

KUBELET SERVER

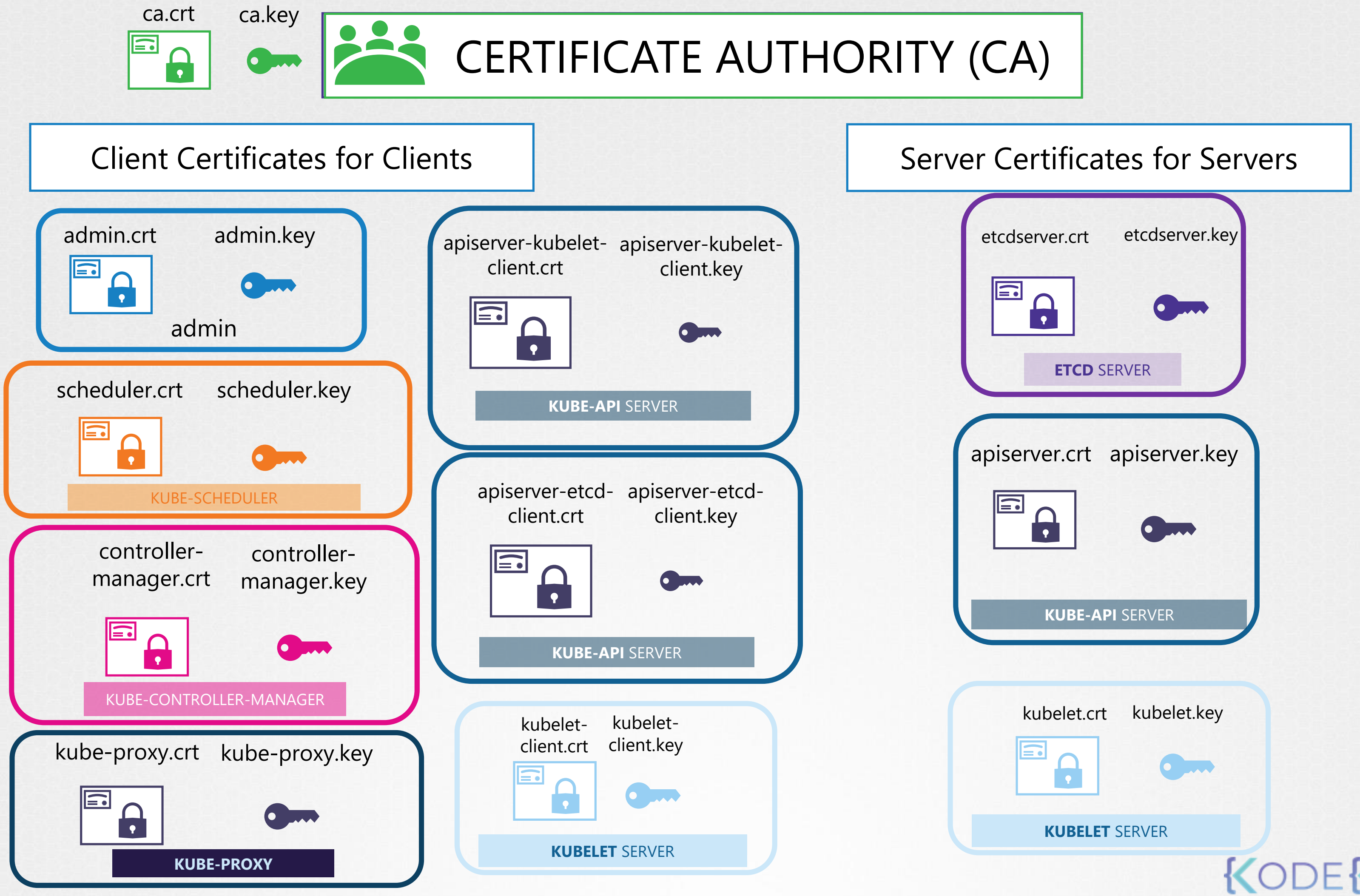
etcdserver.crt etcdserver.key

ETCD SERVER

apiserver-etcd-client.crt apiserver-etcd-client.key

KUBE-API SERVER

CERTIFICATE AUTHORITY (CA)



ca.crt ca.key

Client Certificates for Clients

admin.crt admin.key
admin

scheduler.crt scheduler.key
KUBE-SCHEDULER

controller-manager.crt controller-manager.key
KUBE-CONTROLLER-MANAGER

kube-proxy.crt kube-proxy.key
KUBE-PROXY

apiserver-kubelet-client.crt apiserver-kubelet-client.key
KUBE-API SERVER

apiserver-etcd-client.crt apiserver-etcd-client.key
KUBE-API SERVER

kubelet-client.crt kubelet-client.key
KUBELET SERVER

Server Certificates for Servers

etcdserver.crt etcdserver.key
ETCD SERVER

apiserver.crt apiserver.key
KUBE-API SERVER

kubelet.crt kubelet.key
KUBELET SERVER

KODEKLOUD

KODEKLOUD

Course Objectives

- Core Concepts
- Scheduling
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- Security
  - ○ Kubernetes Security Primitives
  - ○ Secure Persistent Key Value Store
  - ○ Authentication
  - ○ Authorization
  - ○ Security Contexts
  - ○ TLS Certificates for Cluster Components
  - ○ Images Securely
  - ○ Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

TLS CERTIFICATES

Generate Certificates

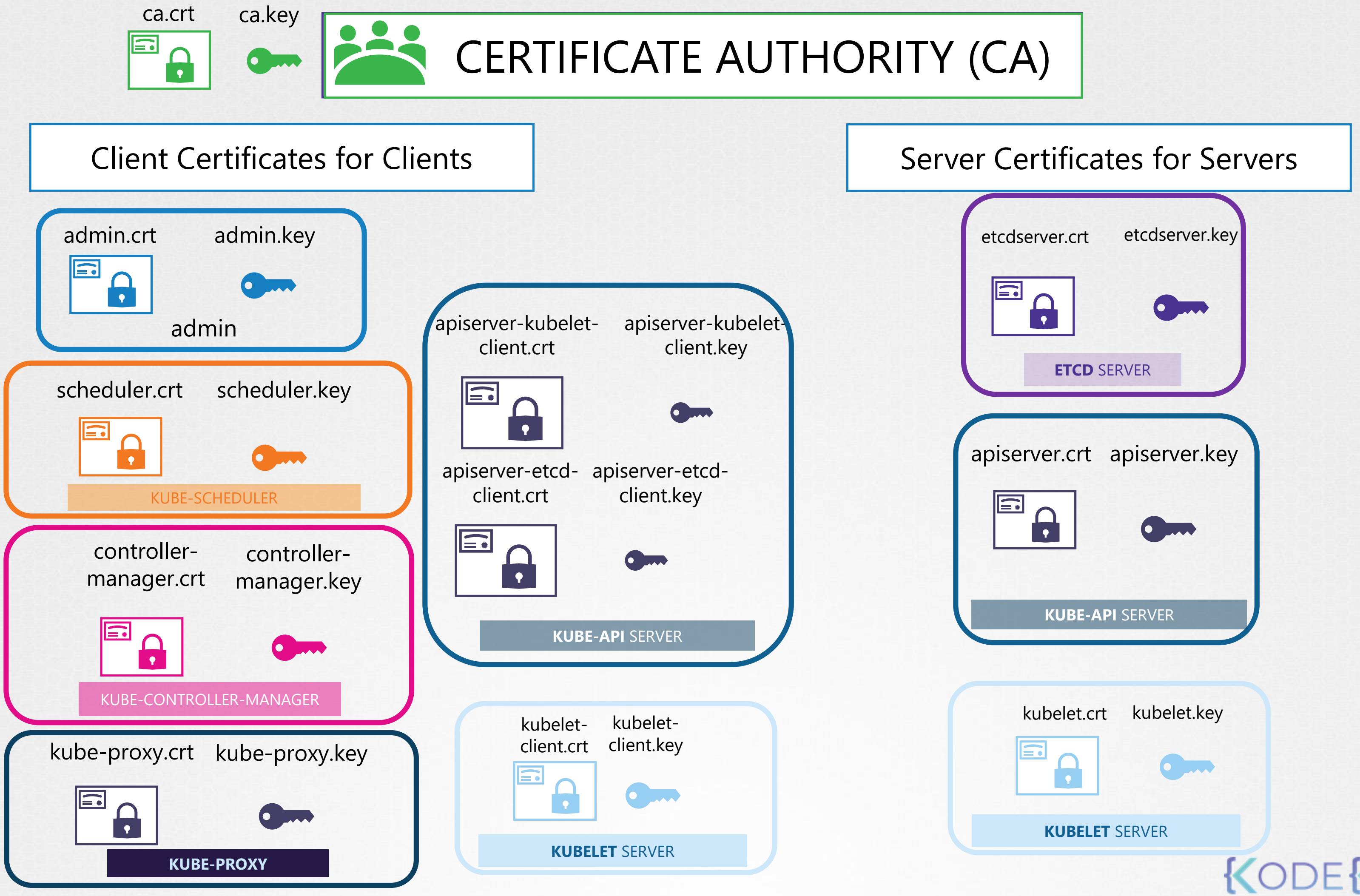
EASYRSA

OPENSSL

CFSSL

OPENSSL

CERTIFICATE AUTHORITY (CA)



ca.crt ca.key

Client Certificates for Clients

admin.crt admin.key

admin

scheduler.crt scheduler.key

KUBE-SCHEDULER

controller-manager.crt controller-manager.key

KUBE-CONTROLLER-MANAGER

kube-proxy.crt kube-proxy.key

KUBE-PROXY

apiserver-kubelet-client.crt apiserver-kubelet-client.key

apiserver-etcd-client.crt apiserver-etcd-client.key

KUBE-API SERVER

kubelet-client.crt kubelet-client.key

KUBELET SERVER

Server Certificates for Servers

etcdserver.crt etcdserver.key

ETCD SERVER

apiserver.crt apiserver.key

KUBE-API SERVER

kubelet.crt kubelet.key

KUBELET SERVER

CERTIFICATE AUTHORITY (CA)

Generate Keys

ca.key

```
openssl genrsa -out ca.key 2048
ca.key
```

```
new -key ca.key -subj  "/CN=KUBERNETES-CA" -out ca.csr
```

```
-req -in ca.csr -signkey ca.key -out ca.crt
```

CERTIFICATE

This Certificate Proudly Presented to

KUBERNETES_CA

MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

NEW YORK
NY, US

Issued by: ✓

ca.key

ca.crt

ADMIN USER

Generate Keys

admin.key

```
openssl genrsa -out admin.key 2048
admin.key
```

Certificate Signing Request

admin.csr

```
openssl req -new -key admin.key -subj  \
        "/CN=kube-admin/OU=system:masters" -out admin.csr
```

```
q -in admin.csr –CA ca.crt -CAkey ca.key -out admin.crt
```

CERTIFICATE

Group:
SYSTEM:MASTERS

This Certificate Proudly Presented to

KUBE-ADMIN

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by: ✓

KUBE SCHEDULER

ca.key

ca.crt

Generate Keys

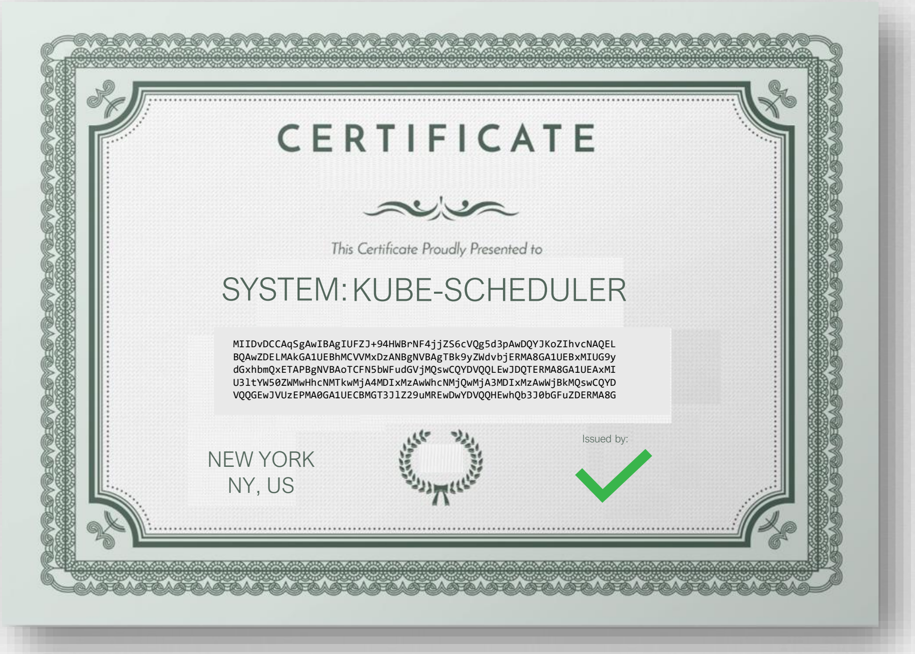
Certificate Signing Request

Sign Certificates

scheduler.key

scheduler.csr

scheduler.crt



CERTIFICATE

This Certificate Proudly Presented to

SYSTEM: KUBE-SCHEDULER

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by: ✓

KUBE CONTROLLER MANGER

ca.key

ca.crt

Generate Keys

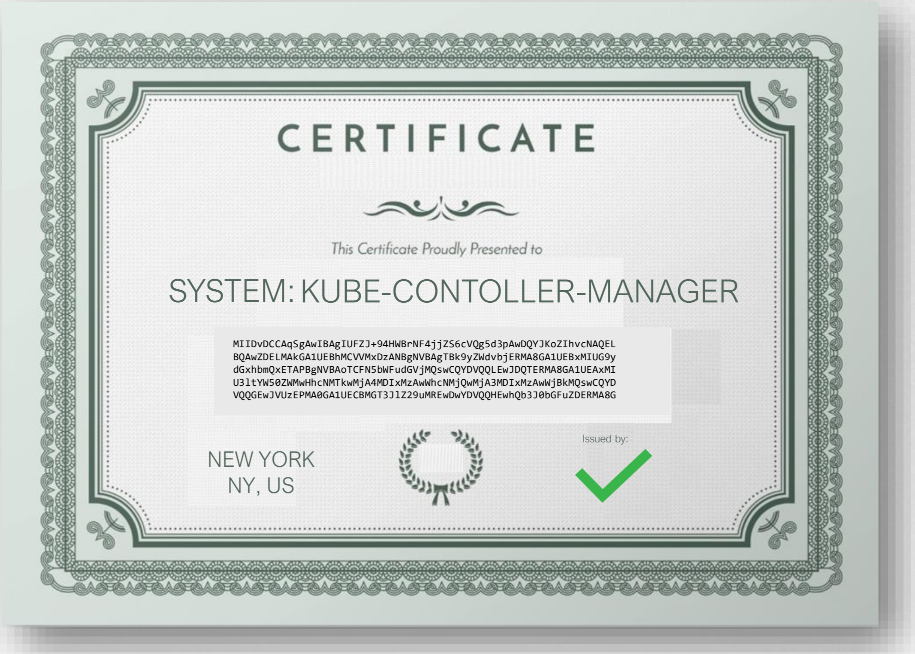
controller-manager.key

Certificate Signing Request

controller-manager.csr

Sign Certificates

controller-manager.crt



CERTIFICATE

This Certificate Proudly Presented to

SYSTEM: KUBE-CONTOLLER-MANAGER

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by: ✓

ca.key

ca.crt

KUBE PROXY

Generate Keys

kube-proxy.key

Certificate Signing Request

kube-proxy.csr

Sign Certificates

kube-proxy.crt

CERTIFICATE

This Certificate Proudly Presented to

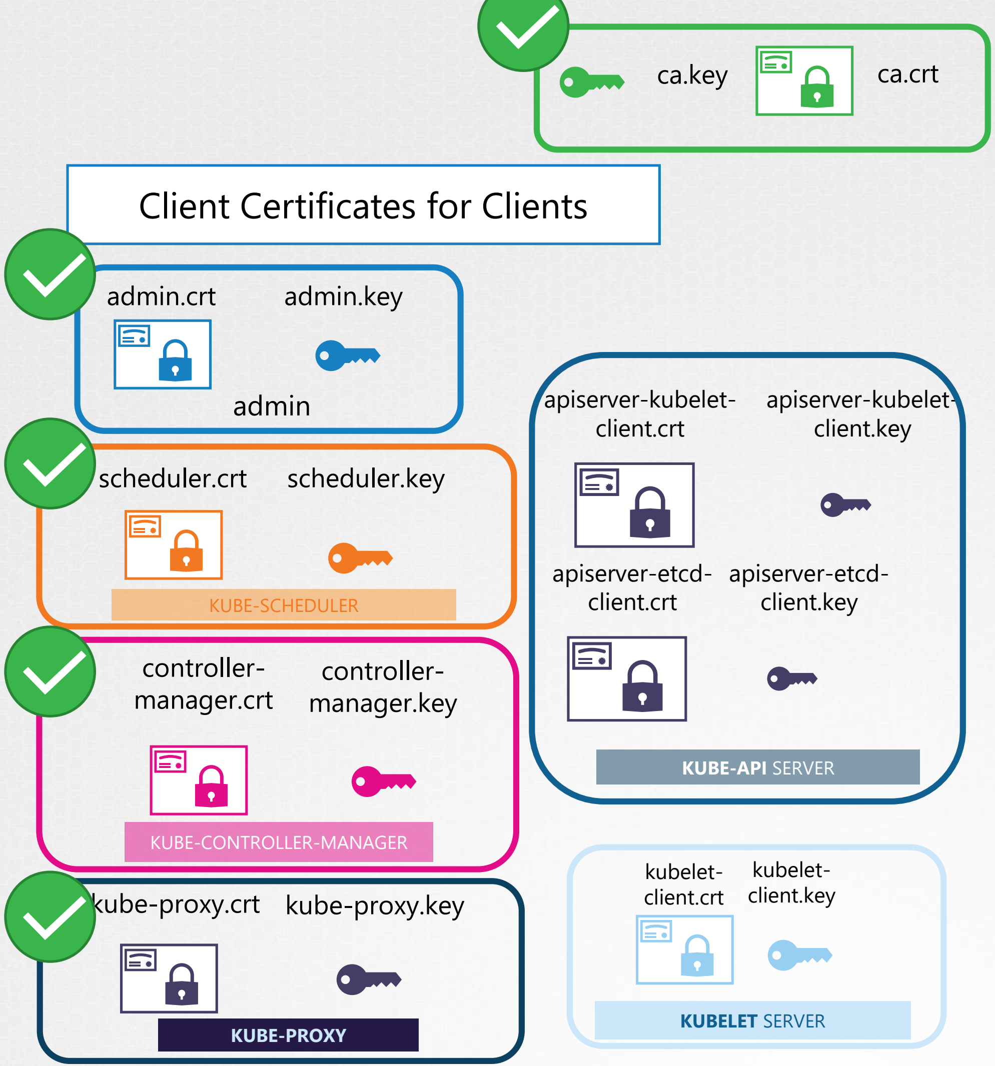
KUBE-PROXY

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by: ✓

Client Certificates for Clients



ca.key

ca.crt

admin.crt

admin.key

admin

scheduler.crt

scheduler.key

KUBE-SCHEDULER

controller-manager.crt

controller-manager.key

KUBE-CONTROLLER-MANAGER

kube-proxy.crt

kube-proxy.key

KUBE-PROXY

apiserver-kubelet-client.crt

apiserver-kubelet-client.key

apiserver-etcd-client.crt

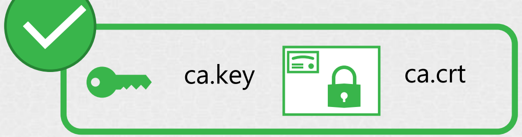
apiserver-etcd-client.key

KUBE-API SERVER

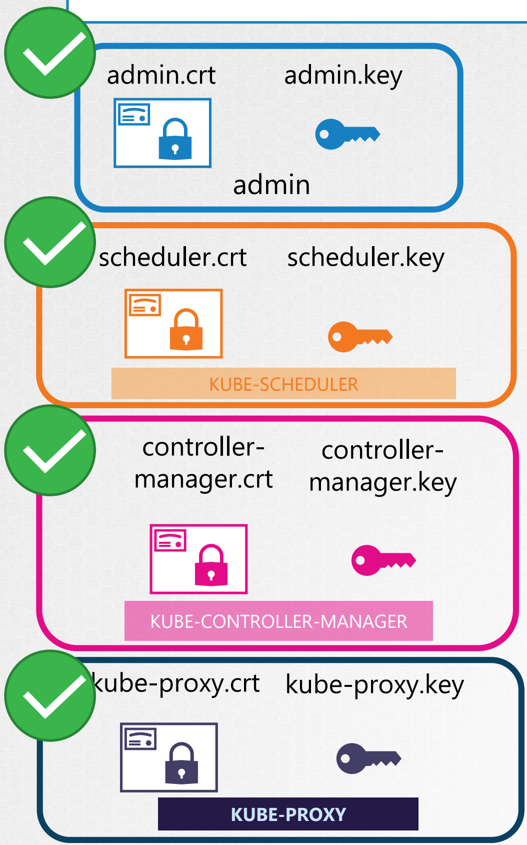
kubelet-client.crt

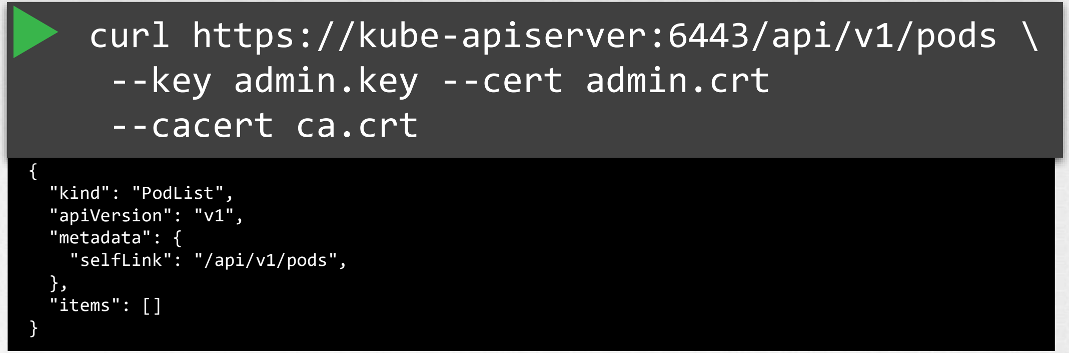
kubelet-client.key

KUBELET SERVER



Client Certificates for Clients



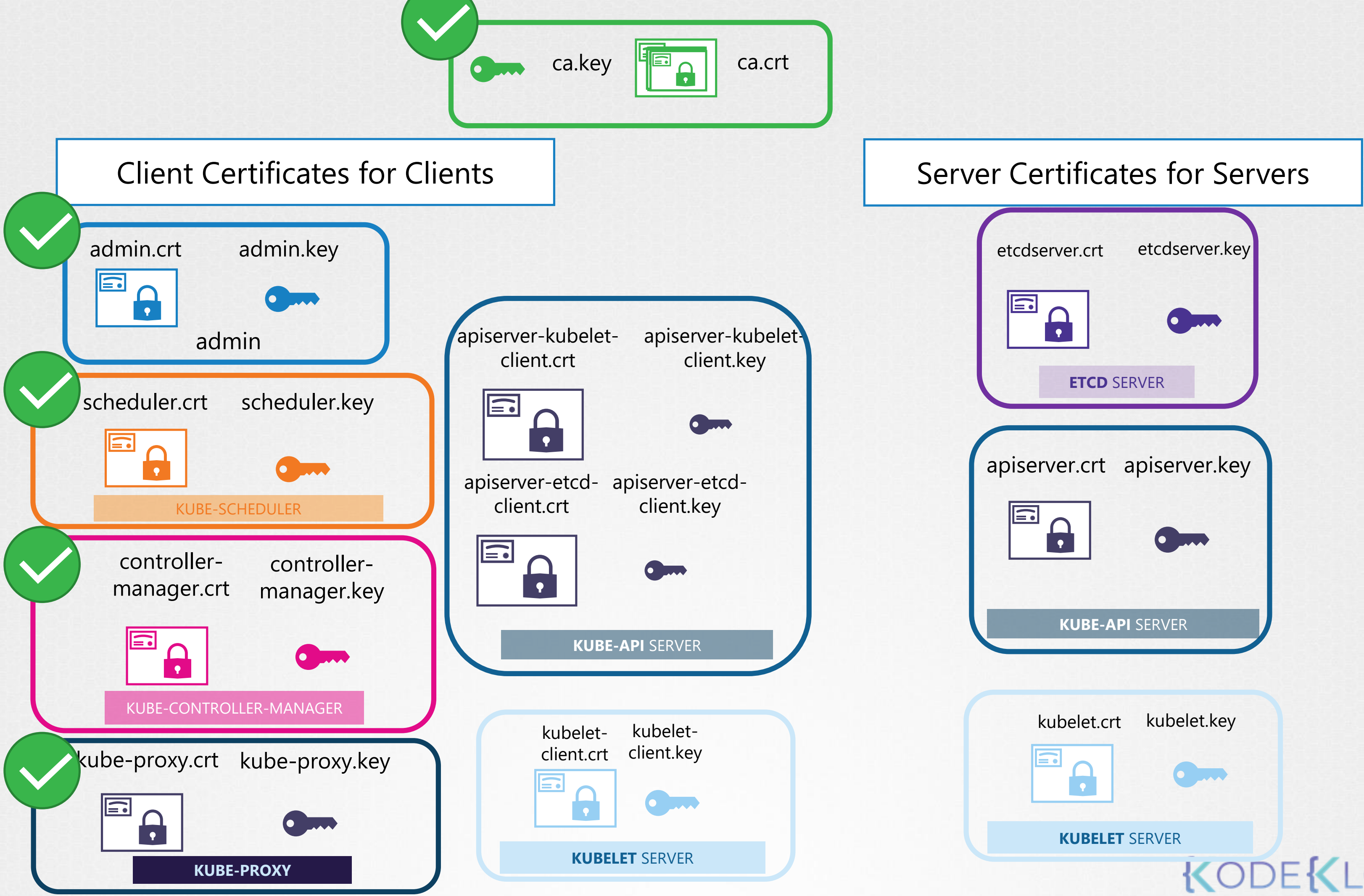


```
curl https://kube-apiserver:6443/api/v1/pods \
  --key admin.key --cert admin.crt
  --cacert ca.crt
```

```
{
  "kind": "PodList",
  "apiVersion": "v1",
  "metadata": {
    "selfLink": "/api/v1/pods",
  },
  "items": []
}
```

kube-config.yaml

```
apiVersion: v1
clusters:
- cluster:
    certificate-authority: ca.crt
    server: https://kube-apiserver:6443
  name: kubernetes
kind: Config
users:
- name: kubernetes-admin
  user:
    client-certificate: admin.crt
    client-key: admin.key
```



ca.key ca.crt

Client Certificates for Clients

admin.crt admin.key

admin

scheduler.crt scheduler.key

KUBE-SCHEDULER

controller-manager.crt controller-manager.key

KUBE-CONTROLLER-MANAGER

kube-proxy.crt kube-proxy.key

KUBE-PROXY

apiserver-kubelet-client.crt apiserver-kubelet-client.key

apiserver-etcd-client.crt apiserver-etcd-client.key

KUBE-API SERVER

kubelet-client.crt kubelet-client.key

KUBELET SERVER

Server Certificates for Servers

etcdserver.crt etcdserver.key

ETCD SERVER

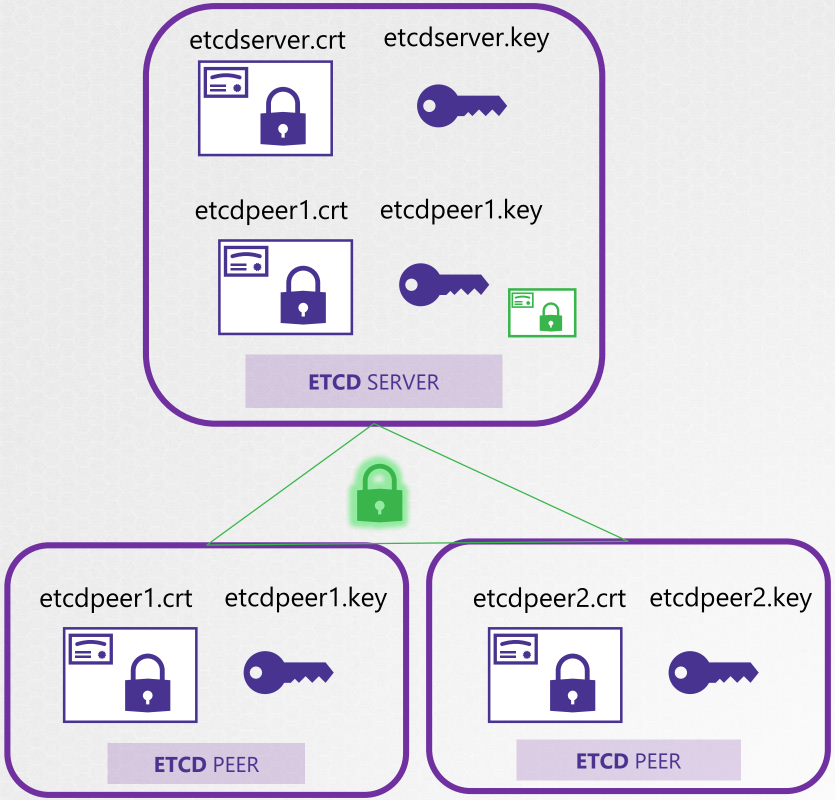
apiserver.crt apiserver.key

KUBE-API SERVER

kubelet.crt kubelet.key

KUBELET SERVER

ETCD SERVERS



CERTIFICATE

This Certificate Proudly Presented to

ETCD-SERVER

```
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
```

NEW YORK
NY, US

Issued by:

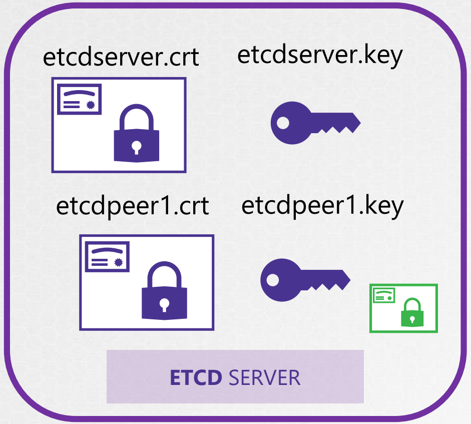
CERTIFICATE

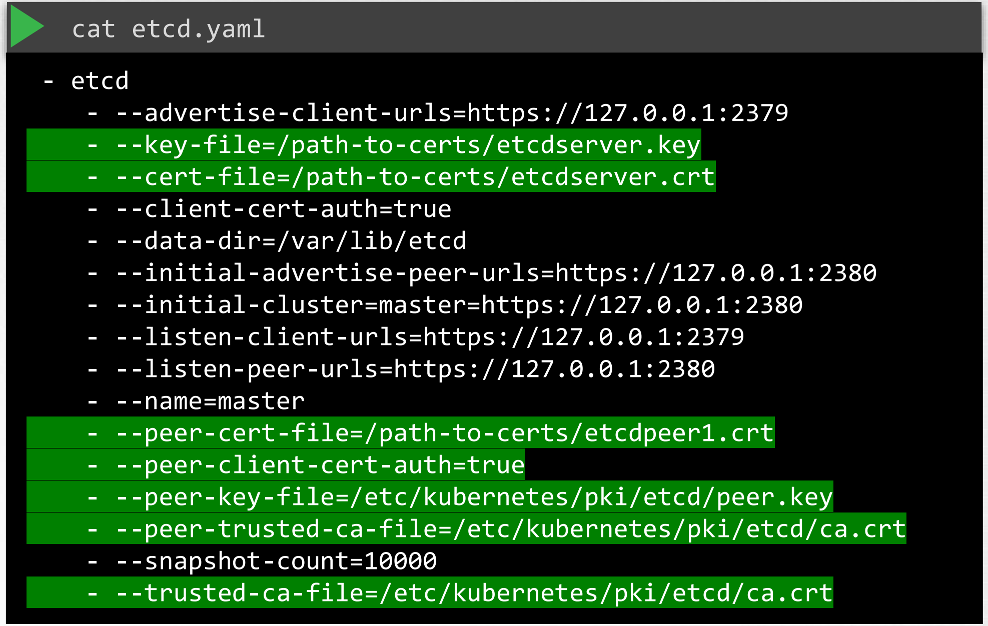
This Certificate Proudly Presented to

ETCD-PEER

NEW YORK
NY, US

ETCD SERVERS

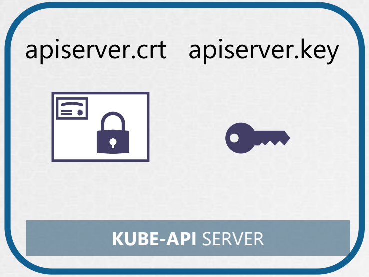




```
cat etcd.yaml
```

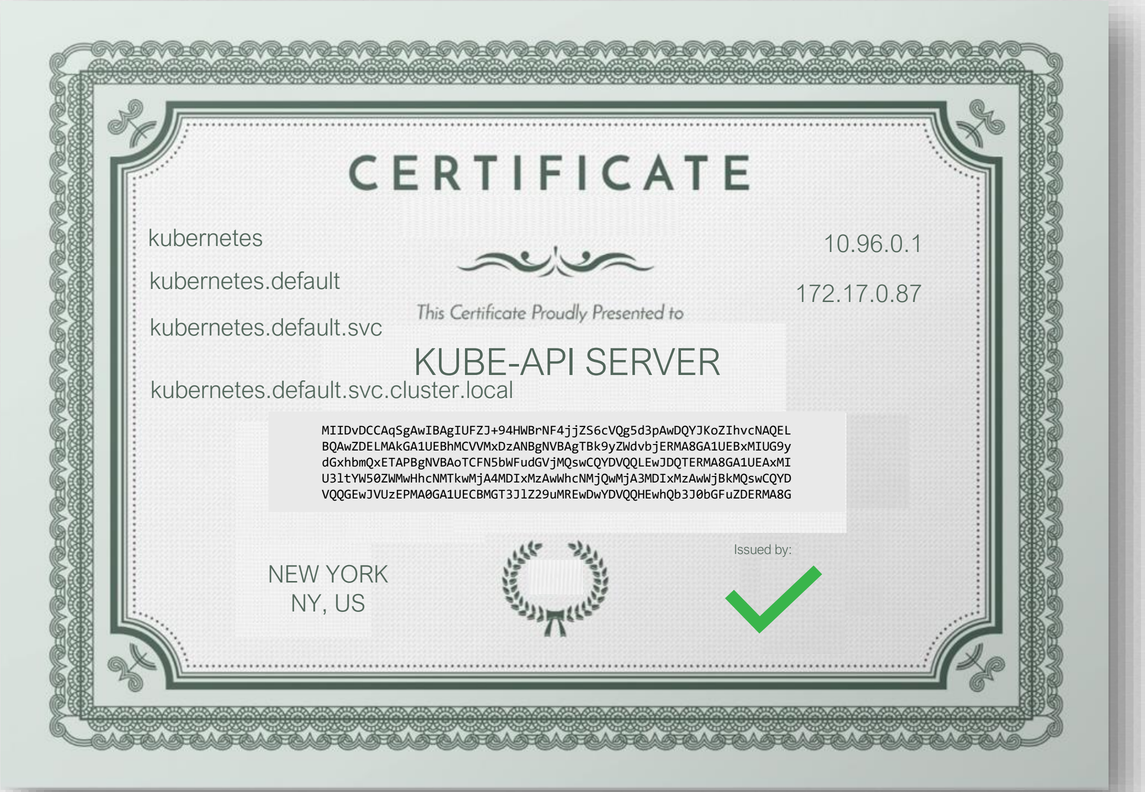
```
- etcd
    - --advertise-client-urls=https://127.0.0.1:2379
    - --key-file=/path-to-certs/etcdserver.key
    - --cert-file=/path-to-certs/etcdserver.crt
    - --client-cert-auth=true
    - --data-dir=/var/lib/etcd
    - --initial-advertise-peer-urls=https://127.0.0.1:2380
    - --initial-cluster=master=https://127.0.0.1:2380
    - --listen-client-urls=https://127.0.0.1:2379
    - --listen-peer-urls=https://127.0.0.1:2380
    - --name=master
    - --peer-cert-file=/path-to-certs/etcdpeer1.crt
    - --peer-client-cert-auth=true
    - --peer-key-file=/etc/kubernetes/pki/etcd/peer.key
    - --peer-trusted-ca-file=/etc/kubernetes/pki/etcd/ca.crt
    - --snapshot-count=10000
    - --trusted-ca-file=/etc/kubernetes/pki/etcd/ca.crt
```

KUBE API SERVER



apiserver.crt apiserver.key

KUBE-API SERVER



CERTIFICATE

kubernetes

kubernetes.default

kubernetes.default.svc

kubernetes.default.svc.cluster.local

10.96.0.1

172.17.0.87

This Certificate Proudly Presented to

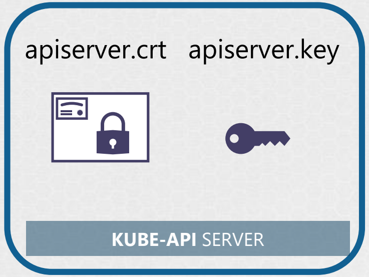
KUBE-API SERVER

MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

NEW YORK
NY, US

Issued by: ✓

KUBE API SERVER

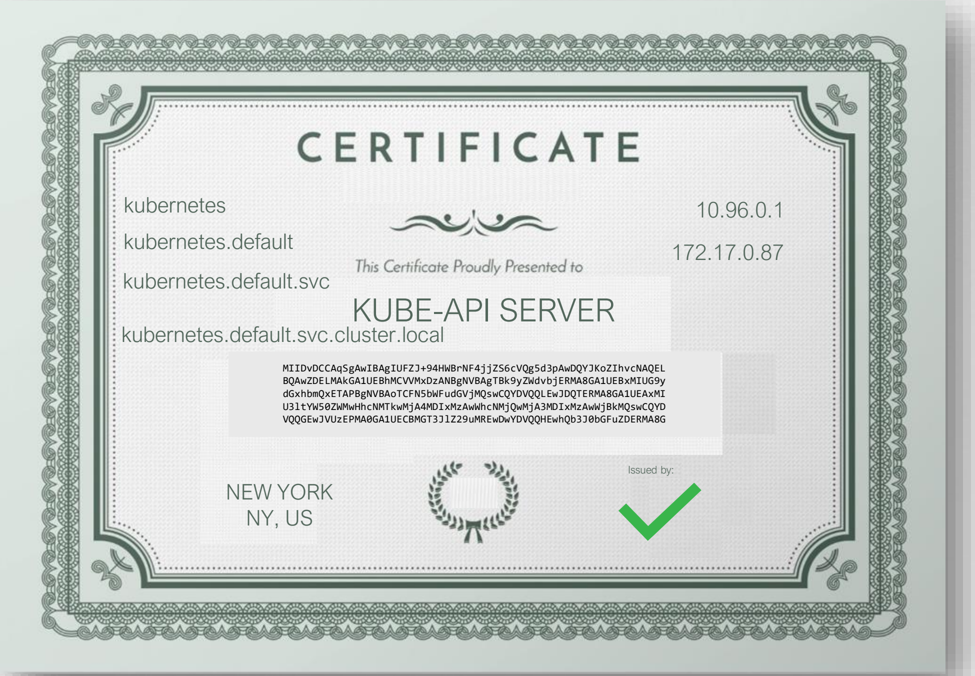


```
openssl genrsa -out apiserver.key 2048
```

```
apiserver.key
```

```
openssl req -new -key apiserrver.key -subj \
        "/CN=kube-apiserver" -out apiserver.csr
```

```
apiserver.csr
```



CERTIFICATE

kubernetes

kubernetes.default

kubernetes.default.svc

kubernetes.default.svc.cluster.local

10.96.0.1

172.17.0.87

This Certificate Proudly Presented to

KUBE-API SERVER

MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

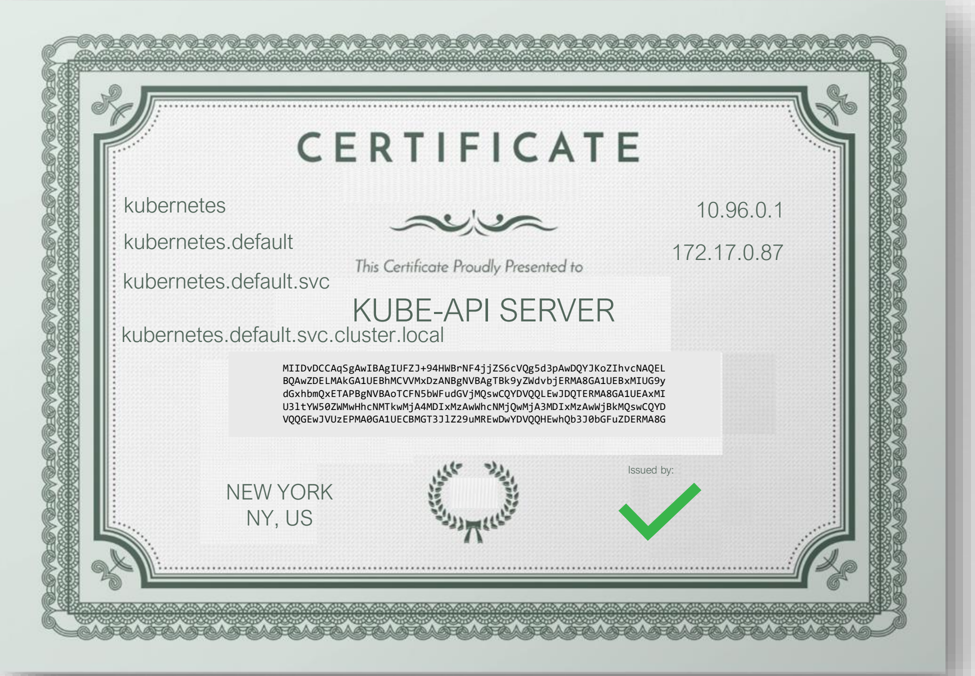
NEW YORK
NY, US

Issued by: ✓

KUBE API SERVER

apiserver.crt apiserver.key

KUBE-API SERVER



CERTIFICATE

kubernetes

kubernetes.default

kubernetes.default.svc

kubernetes.default.svc.cluster.local

10.96.0.1

172.17.0.87

This Certificate Proudly Presented to

KUBE-API SERVER

MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G

NEW YORK
NY, US

Issued by:

```
openssl req -new -key apiserver.key -subj \
    "/CN=kube-apiserver" -out apiserver.csr –config openssl.cnf
```

```
apiserver.csr
```

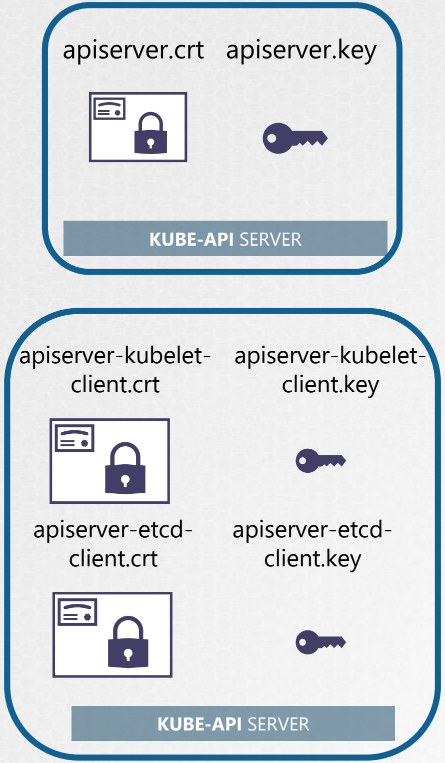
openssl.cnf

```
[req]
req_extensions = v3_req
[ v3_req ]
basicConstraints = CA:FALSE
keyUsage = nonRepudiation,
subjectAltName = @alt_names
[alt_names]
DNS.1 = kubernetes
DNS.2 = kubernetes.default
DNS.3 = kubernetes.default.svc
DNS.4 = kubernetes.default.svc.cluster.local
IP.1 = 10.96.0.1
IP.2 = 172.17.0.87
```

```
openssl x509 -req -in apiserver.csr \
    -CA ca.crt -CAkey ca.key -out apiserver.crt
```

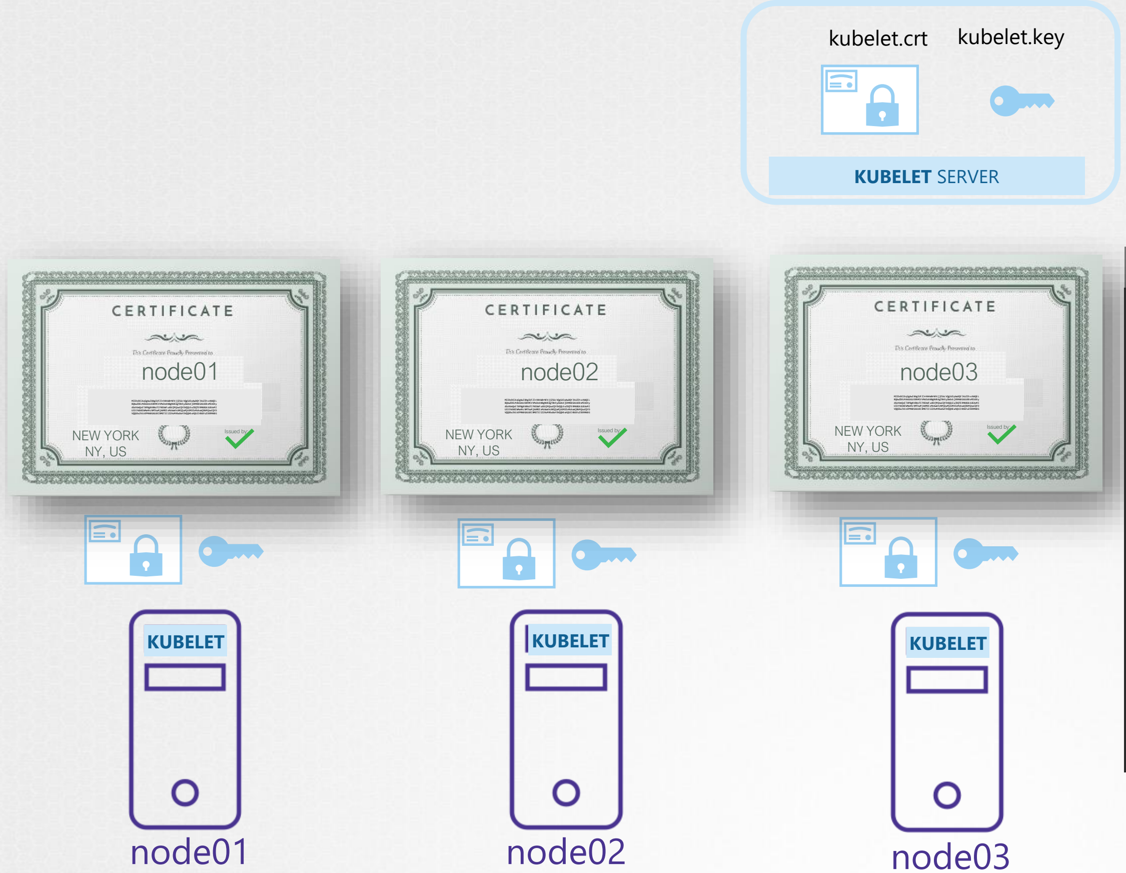
```
apiserver.crt
```

KUBE API SERVER


apiserver.crt
apiserver.key
KUBE-API SERVER
apiserver-kubelet-client.crt
apiserver-kubelet-client.key
apiserver-etcd-client.crt
apiserver-etcd-client.key
KUBE-API SERVER

```
ExecStart=/usr/local/bin/kube-apiserver \\
  --advertise-address=${INTERNAL_IP} \\
  --allow-privileged=true \\
  --apiserver-count=3 \\
  --authorization-mode=Node,RBAC \\
  --bind-address=0.0.0.0 \\
  --enable-swagger-ui=true \\
  --etcd-cafile=/var/lib/kubernetes/ca.pem \\
  --etcd-certfile=/var/lib/kubernetes/apiserver-etcd-client.crt \\
  --etcd-keyfile=/var/lib/kubernetes/apiserver-etcd-client.key \\
  --etcd-servers=https://127.0.0.1:2379 \\
  --event-ttl=1h \\
  --kubelet-certificate-authority=/var/lib/kubernetes/ca.pem \\
  --kubelet-client-certificate=/var/lib/kubernetes/apiserver-etcd-client.crt \\
  --kubelet-client-key=/var/lib/kubernetes/apiserver-etcd-client.key \\
  --kubelet-https=true \\
  --runtime-config=api/all \\
  --service-account-key-file=/var/lib/kubernetes/service-account.pem \\
  --service-cluster-ip-range=10.32.0.0/24 \\
  --service-node-port-range=30000-32767 \\
  --client-ca-file=/var/lib/kubernetes/ca.pem \\
  --tls-cert-file=/var/lib/kubernetes/apiserver.crt \\
  --tls-private-key-file=/var/lib/kubernetes/apiserver.key \\
  --v=2
```

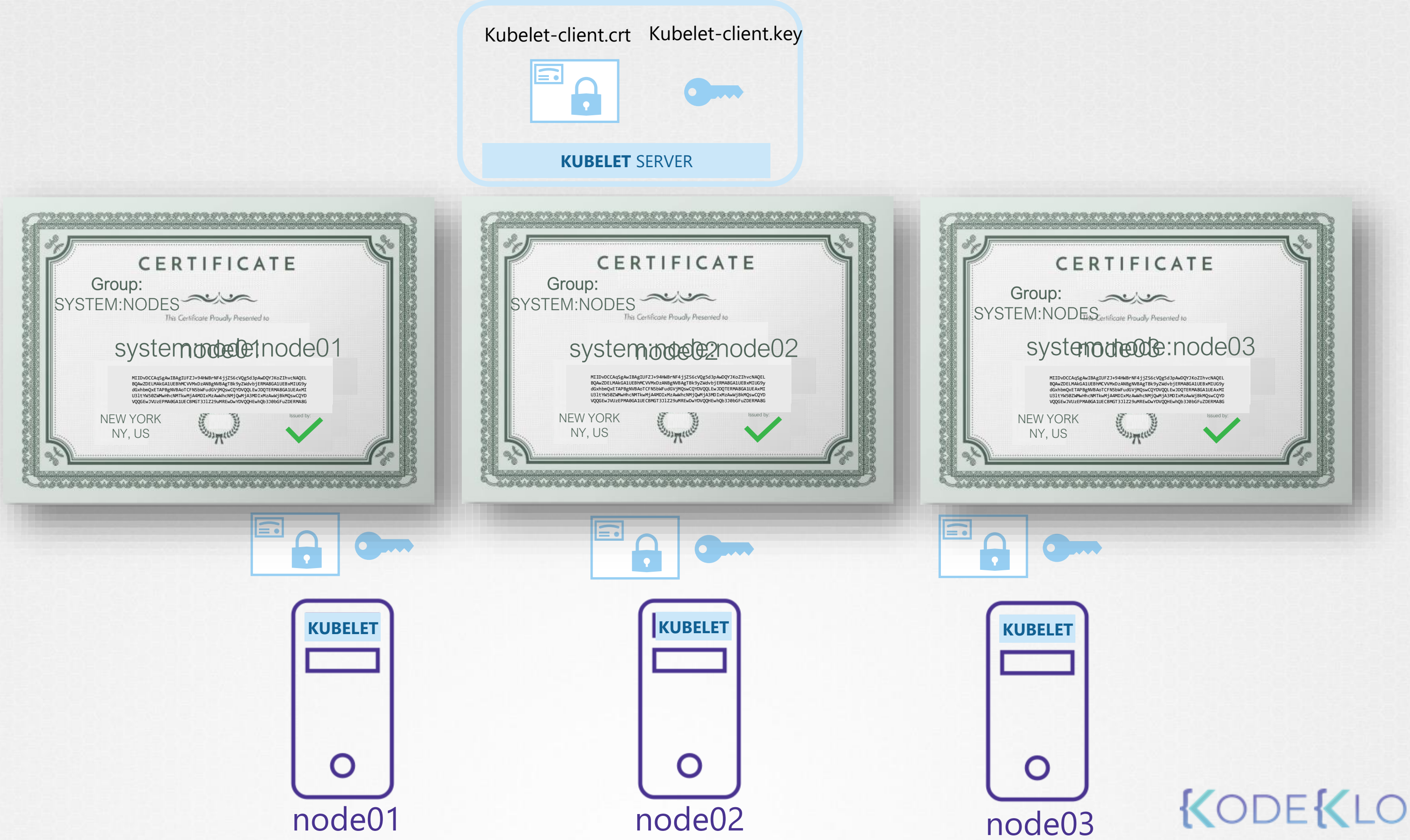
KUBECTL NODES (SERVER CERT)



kubelet-config.yaml (node01)

```yaml
kind: KubeletConfiguration
apiVersion: kubelet.config.k8s.io/v1beta1
authentication:
  x509:
    clientCAFile: "/var/lib/kubernetes/ca.pem"
authorization:
  mode: Webhook
clusterDomain: "cluster.local"
clusterDNS:
  - "10.32.0.10"
podCIDR: "${POD_CIDR}"
resolvConf: "/run/systemd/resolve/resolv.conf"
runtimeRequestTimeout: "15m"
tlsCertFile: "/var/lib/kubelet/kubelet-node01.crt"
tlsPrivateKeyFile: "/var/lib/kubelet/kubelet-
node01.key"
```

KUBECTL NODES (CLIENT CERT)


Kubelet-client.crt
Kubelet-client.key
KUBELET SERVER
CERTIFICATE
Group:
SYSTEM:NODES
This Certificate Proudly Presented to
system:node:node01
node01
MIIDvDCCAqSgAwIBAgIUFZJ+94HWBrNF4jjZS6cVQg5d3pAwDQYJKoZIhvcNAQEL
BQAwZDELMAkGA1UEBhMCVVMxDzANBgNVBAgTBk9yZWdvbjERMA8GA1UEBxMIUG9y
dGxhbmQxETAPBgNVBAoTCFN5bWFudGVjMQswCQYDVQQLEwJDQTERMA8GA1UEAxMI
U3ltYW50ZWMwHhcNMTkwMjA4MDIxMzAwWhcNMjQwMjA3MDIxMzAwWjBkMQswCQYD
VQQGEwJVUzEPMA0GA1UECBMGT3JlZ29uMREwDwYDVQQHEwhQb3J0bGFuZDERMA8G
NEW YORK
NY, US
Issued by:
CERTIFICATE
Group:
SYSTEM:NODES
This Certificate Proudly Presented to
system:node:node02
node02
NEW YORK
NY, US
Issued by:
CERTIFICATE
Group:
SYSTEM:NODES
This Certificate Proudly Presented to
system:node:node03
node03
NEW YORK
NY, US
Issued by:
KUBELET
node01
KUBELET
node02
KUBELET
node03

KODEKLOUD

Course Objectives

- Core Concepts
- Scheduling
- Logging Monitoring
- Application Lifecycle Management
- Cluster Maintenance
- Security
  - ○ Kubernetes Security Primitives
  - ○ Secure Persistent Key Value Store
  - ○ Authentication
  - ○ Authorization
  - ○ Security Contexts
  - ○ TLS Certificates for Cluster Components
  - ○ Images Securely
  - ○ Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

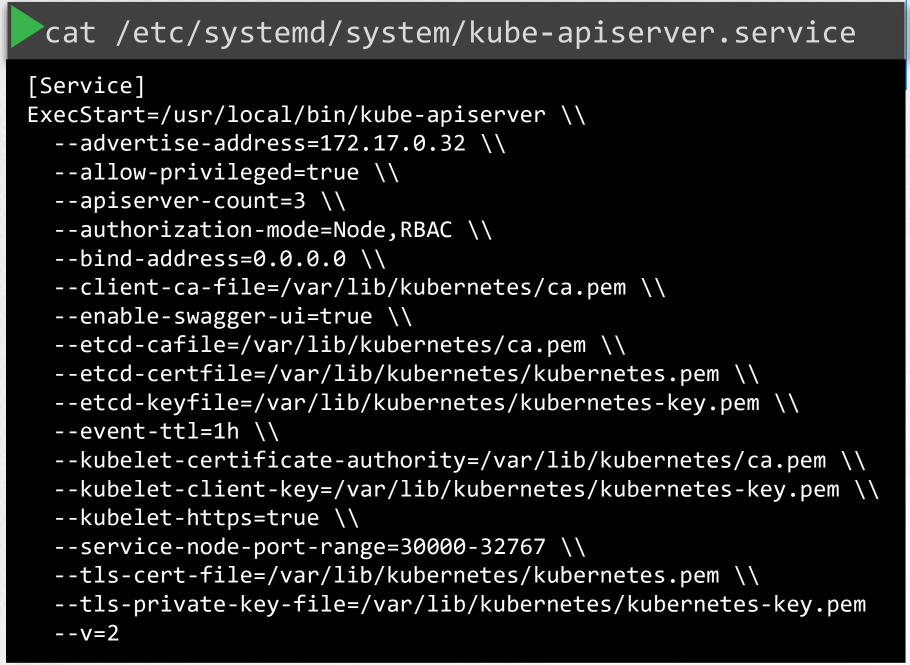
TLS CERTIFICATES

View Certificate Details

“The Hard Way”

kubeadm

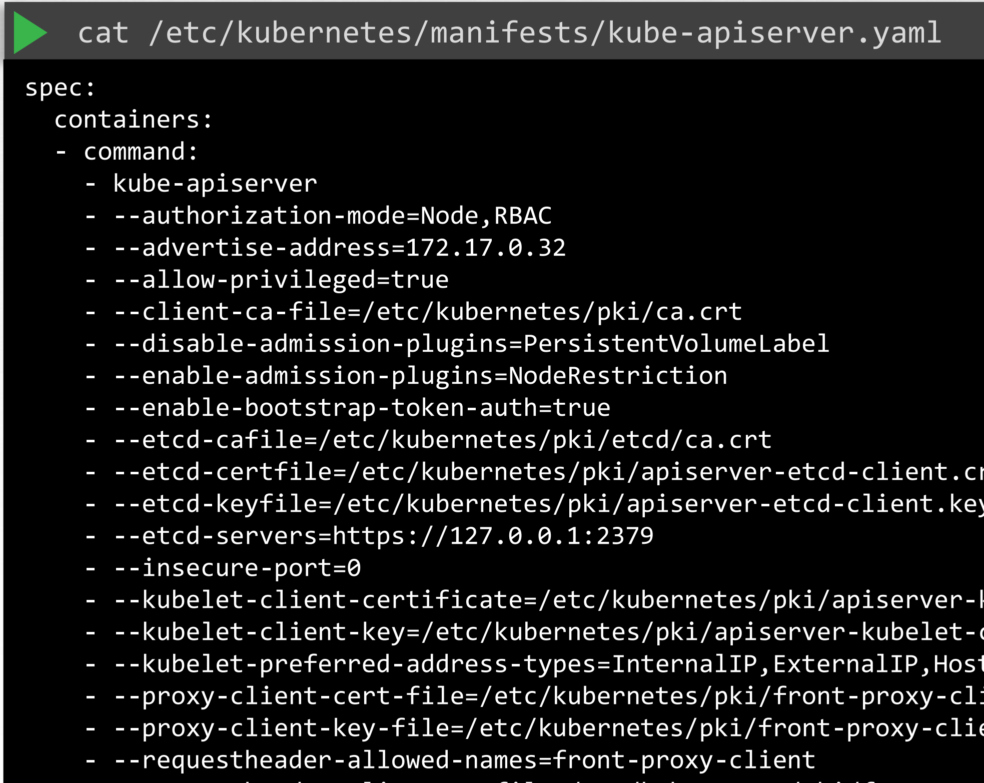
“The Hard Way”



```
cat /etc/systemd/system/kube-apiserver.service
```

```
[Service]
ExecStart=/usr/local/bin/kube-apiserver \\
  --advertise-address=172.17.0.32 \\
  --allow-privileged=true \\
  --apiserver-count=3 \\
  --authorization-mode=Node,RBAC \\
  --bind-address=0.0.0.0 \\
  --client-ca-file=/var/lib/kubernetes/ca.pem \\
  --enable-swagger-ui=true \\
  --etcd-cafile=/var/lib/kubernetes/ca.pem \\
  --etcd-certfile=/var/lib/kubernetes/kubernetes.pem \\
  --etcd-keyfile=/var/lib/kubernetes/kubernetes-key.pem \\
  --event-ttl=1h \\
  --kubelet-certificate-authority=/var/lib/kubernetes/ca.pem \\
  --kubelet-client-key=/var/lib/kubernetes/kubernetes-key.pem \\
  --kubelet-https=true \\
  --service-node-port-range=30000-32767 \\
  --tls-cert-file=/var/lib/kubernetes/kubernetes.pem \\
  --tls-private-key-file=/var/lib/kubernetes/kubernetes-key.pem
  --v=2
```

kubeadm

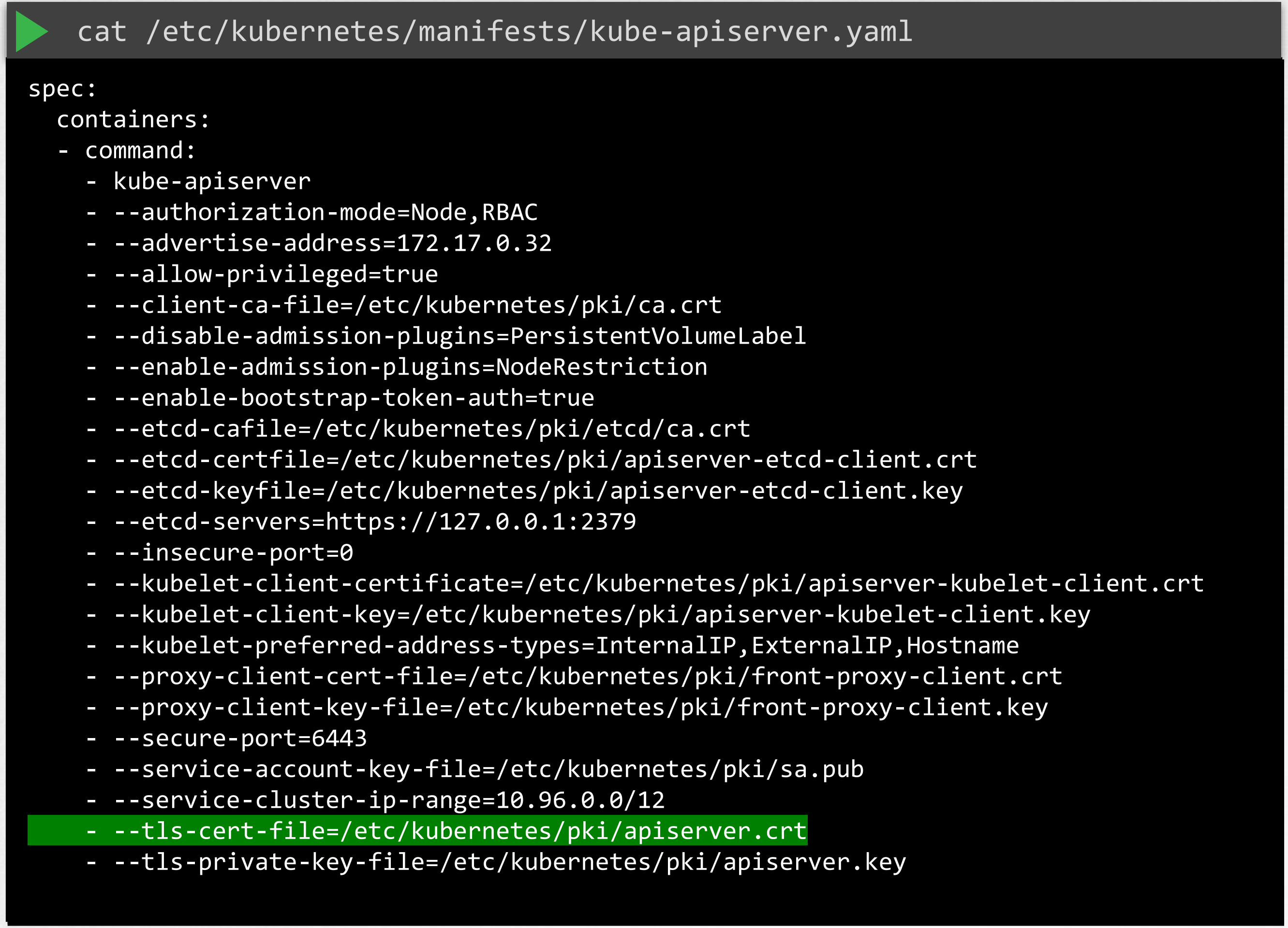


```
cat /etc/kubernetes/manifests/kube-apiserver.yaml
```

```
spec:
  containers:
  - command:
    - kube-apiserver
    - --authorization-mode=Node,RBAC
    - --advertise-address=172.17.0.32
    - --allow-privileged=true
    - --client-ca-file=/etc/kubernetes/pki/ca.crt
    - --disable-admission-plugins=PersistentVolumeLabel
    - --enable-admission-plugins=NodeRestriction
    - --enable-bootstrap-token-auth=true
    - --etcd-cafile=/etc/kubernetes/pki/etcd/ca.crt
    - --etcd-certfile=/etc/kubernetes/pki/apiserver-etcd-client.cr
    - --etcd-keyfile=/etc/kubernetes/pki/apiserver-etcd-client.key
    - --etcd-servers=https://127.0.0.1:2379
    - --insecure-port=0
    - --kubelet-client-certificate=/etc/kubernetes/pki/apiserver-k
    - --kubelet-client-key=/etc/kubernetes/pki/apiserver-kubelet-c
    - --kubelet-preferred-address-types=InternalIP,ExternalIP,Host
    - --proxy-client-cert-file=/etc/kubernetes/pki/front-proxy-cli
    - --proxy-client-key-file=/etc/kubernetes/pki/front-proxy-clie
    - --requestheader-allowed-names=front-proxy-client
```

kubeadm

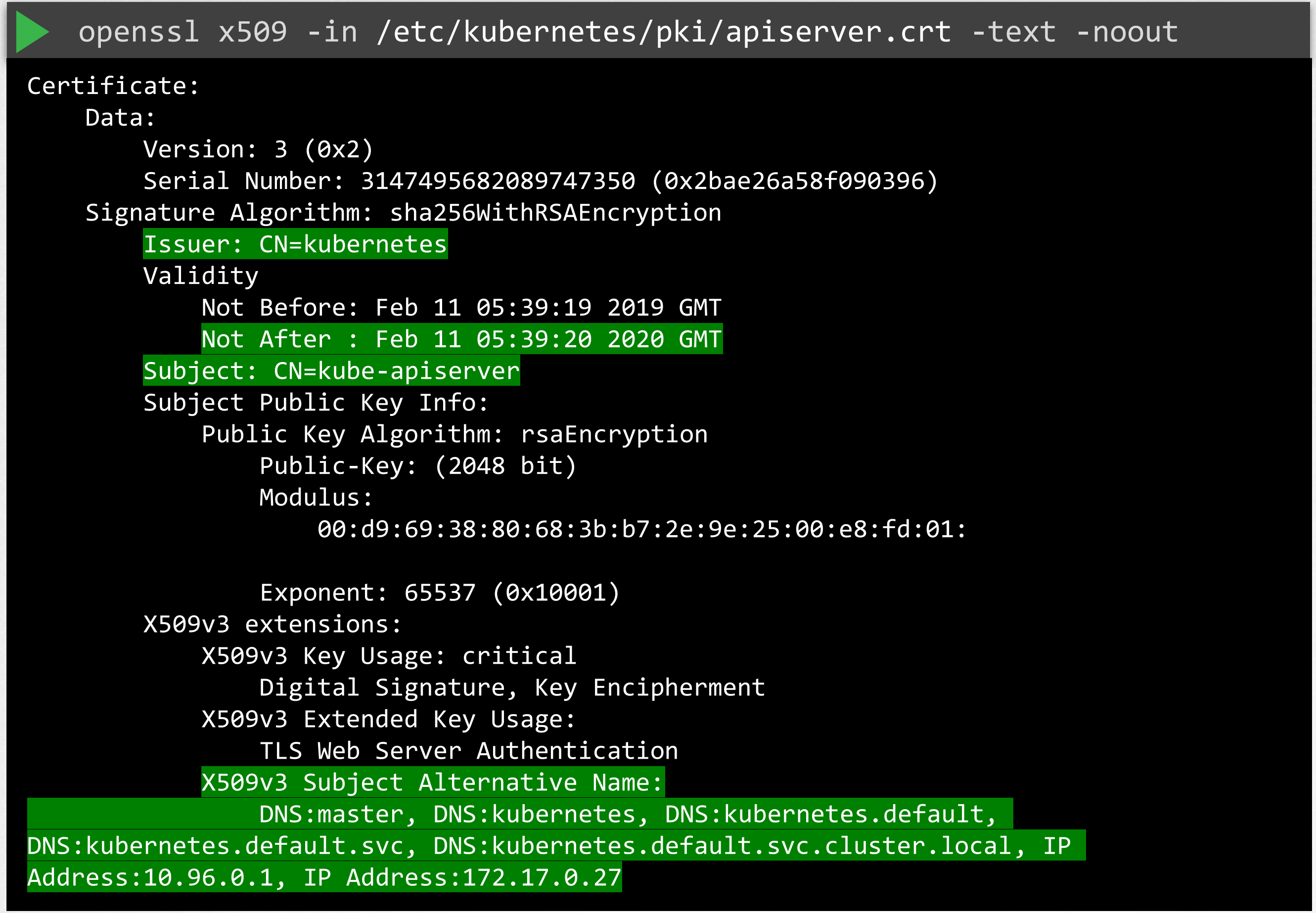
Component	Type	Certificate Path	CN Name	ALT Names	Organization	Issuer	Expiration
kube-apiserver	Server						
kube-apiserver	Server						
kube-apiserver	Server						
kube-apiserver	Client (Kubelet)						
kube-apiserver	Client (Kubelet)						
kube-apiserver	Client (Etcd)						
kube-apiserver	Client (Etcd)						
kube-apiserver	Client (Etcd)						



```
cat /etc/kubernetes/manifests/kube-apiserver.yaml
```

```
spec:
  containers:
  - command:
    - kube-apiserver
    - --authorization-mode=Node,RBAC
    - --advertise-address=172.17.0.32
    - --allow-privileged=true
    - --client-ca-file=/etc/kubernetes/pki/ca.crt
    - --disable-admission-plugins=PersistentVolumeLabel
    - --enable-admission-plugins=NodeRestriction
    - --enable-bootstrap-token-auth=true
    - --etcd-cafile=/etc/kubernetes/pki/etcd/ca.crt
    - --etcd-certfile=/etc/kubernetes/pki/apiserver-etcd-client.crt
    - --etcd-keyfile=/etc/kubernetes/pki/apiserver-etcd-client.key
    - --etcd-servers=https://127.0.0.1:2379
    - --insecure-port=0
    - --kubelet-client-certificate=/etc/kubernetes/pki/apiserver-kubelet-client.crt
    - --kubelet-client-key=/etc/kubernetes/pki/apiserver-kubelet-client.key
    - --kubelet-preferred-address-types=InternalIP,ExternalIP,Hostname
    - --proxy-client-cert-file=/etc/kubernetes/pki/front-proxy-client.crt
    - --proxy-client-key-file=/etc/kubernetes/pki/front-proxy-client.key
    - --secure-port=6443
    - --service-account-key-file=/etc/kubernetes/pki/sa.pub
    - --service-cluster-ip-range=10.96.0.0/12
    - --tls-cert-file=/etc/kubernetes/pki/apiserver.crt
    - --tls-private-key-file=/etc/kubernetes/pki/apiserver.key
```

/etc/kubernetes/pki/apiserver.crt

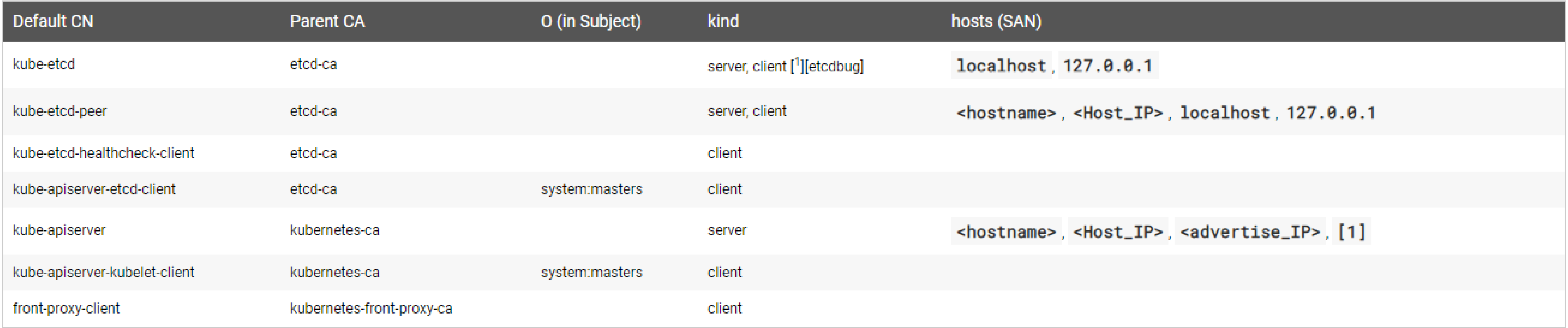


```
openssl x509 -in /etc/kubernetes/pki/apiserver.crt -text -noout
```

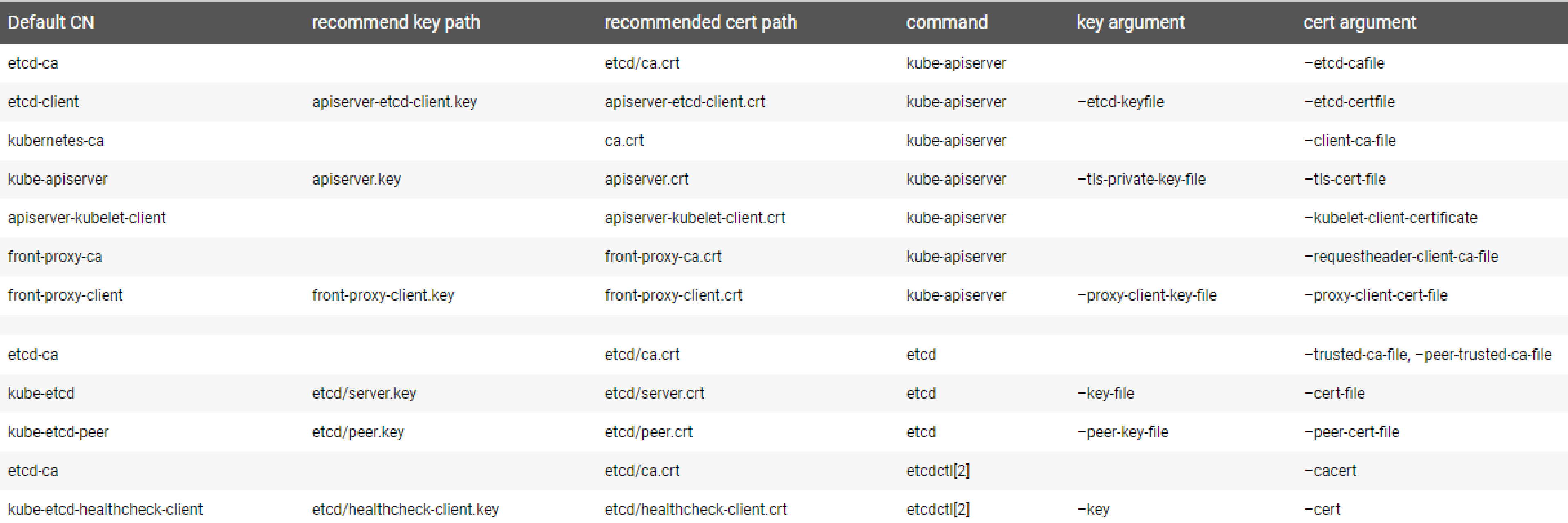
```
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number: 3147495682089747350 (0x2bae26a58f090396)
    Signature Algorithm: sha256WithRSAEncryption
        Issuer: CN=kubernetes
        Validity
            Not Before: Feb 11 05:39:19 2019 GMT
            Not After : Feb 11 05:39:20 2020 GMT
        Subject: CN=kube-apiserver
        Subject Public Key Info:
            Public Key Algorithm: rsaEncryption
                Public-Key: (2048 bit)
                Modulus:
                    00:d9:69:38:80:68:3b:b7:2e:9e:25:00:e8:fd:01:

                Exponent: 65537 (0x10001)
        X509v3 extensions:
            X509v3 Key Usage: critical
                Digital Signature, Key Encipherment
            X509v3 Extended Key Usage:
                TLS Web Server Authentication
            X509v3 Subject Alternative Name:
                DNS:master, DNS:kubernetes, DNS:kubernetes.default,
DNS:kubernetes.default.svc, DNS:kubernetes.default.svc.cluster.local, IP
Address:10.96.0.1, IP Address:172.17.0.27
```

kubeadm

Certificate Path	CN Name	ALT Names	Organization	Issuer	Expiration
/etc/kubernetes/pki/apiserver.crt	kube-apiserver	DNS:master DNS:kubernetes DNS:kubernetes.default DNS:kubernetes.default.svc IP Address:10.96.0.1 IP Address:172.17.0.27		kubernetes	Feb 11 05:39:20 2020
/etc/kubernetes/pki/apiserver.key					
/etc/kubernetes/pki/ca.crt	kubernetes			kubernetes	Feb 8 05:39:19 2029
/etc/kubernetes/pki/apiserver-kubelet-client.crt	kube-apiserver-kubelet-client		system:masters	kubernetes	Feb 11 05:39:20 2020
/etc/kubernetes/pki/apiserver-kubelet-client.key					
/etc/kubernetes/pki/apiserver-etcd-client.crt	kube-apiserver-etcd-client		system:masters	self	Feb 11 05:39:22 2020
/etc/kubernetes/pki/apiserver-etcd-client.key					
/etc/kubernetes/pki/etcd/ca.crt	kubernetes			kubernetes	Feb 8 05:39:21 2017

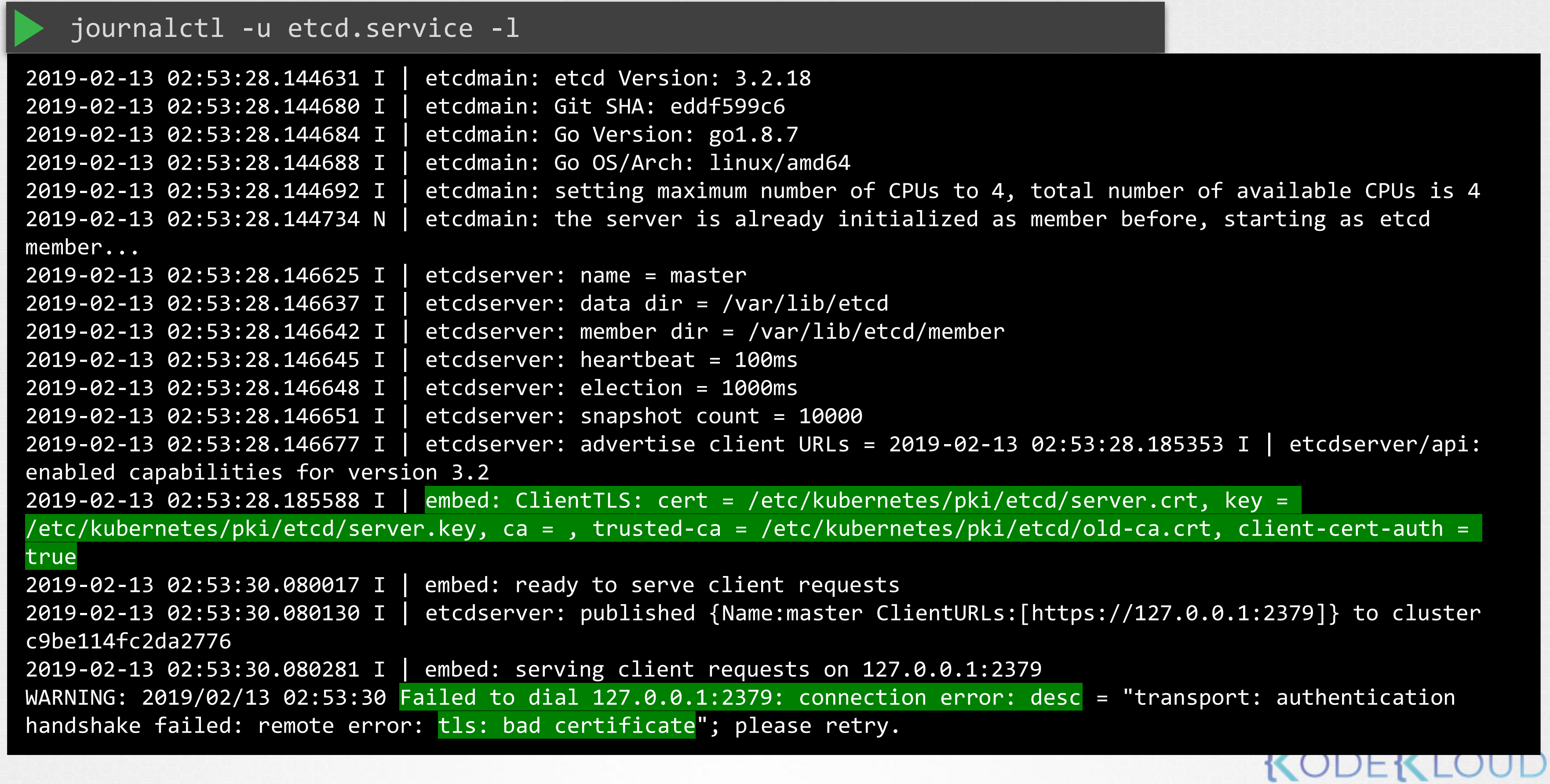


Default CN	Parent CA	O (in Subject)	kind	hosts (SAN)
kube-etcd	etcd-ca		server, client [1][etcdbug]	`localhost`, `127.0.0.1`
kube-etcd-peer	etcd-ca		server, client	`<hostname>`, `<Host_IP>`, `localhost`, `127.0.0.1`
kube-etcd-healthcheck-client	etcd-ca		client	
kube-apiserver-etcd-client	etcd-ca	system:masters	client	
kube-apiserver	kubernetes-ca		server	`<hostname>`, `<Host_IP>`, `<advertise_IP>`, `[1]`
kube-apiserver-kubelet-client	kubernetes-ca	system:masters	client	
front-proxy-client	kubernetes-front-proxy-ca		client	



Default CN	recommend key path	recommended cert path	command	key argument	cert argument
etcd-ca		etcd/ca.crt	kube-apiserver		−etcd-cafile
etcd-client	apiserver-etcd-client.key	apiserver-etcd-client.crt	kube-apiserver	−etcd-keyfile	−etcd-certfile
kubernetes-ca		ca.crt	kube-apiserver		−client-ca-file
kube-apiserver	apiserver.key	apiserver.crt	kube-apiserver	−tls-private-key-file	−tls-cert-file
apiserver-kubelet-client		apiserver-kubelet-client.crt	kube-apiserver		−kubelet-client-certificate
front-proxy-ca		front-proxy-ca.crt	kube-apiserver		−requestheader-client-ca-file
front-proxy-client	front-proxy-client.key	front-proxy-client.crt	kube-apiserver	−proxy-client-key-file	−proxy-client-cert-file
etcd-ca		etcd/ca.crt	etcd		−trusted-ca-file, −peer-trusted-ca-file
kube-etcd	etcd/server.key	etcd/server.crt	etcd	−key-file	−cert-file
kube-etcd-peer	etcd/peer.key	etcd/peer.crt	etcd	−peer-key-file	−peer-cert-file
etcd-ca		etcd/ca.crt	etcdctl[2]		−cacert
kube-etcd-healthcheck-client	etcd/healthcheck-client.key	etcd/healthcheck-client.crt	etcdctl[2]	−key	−cert

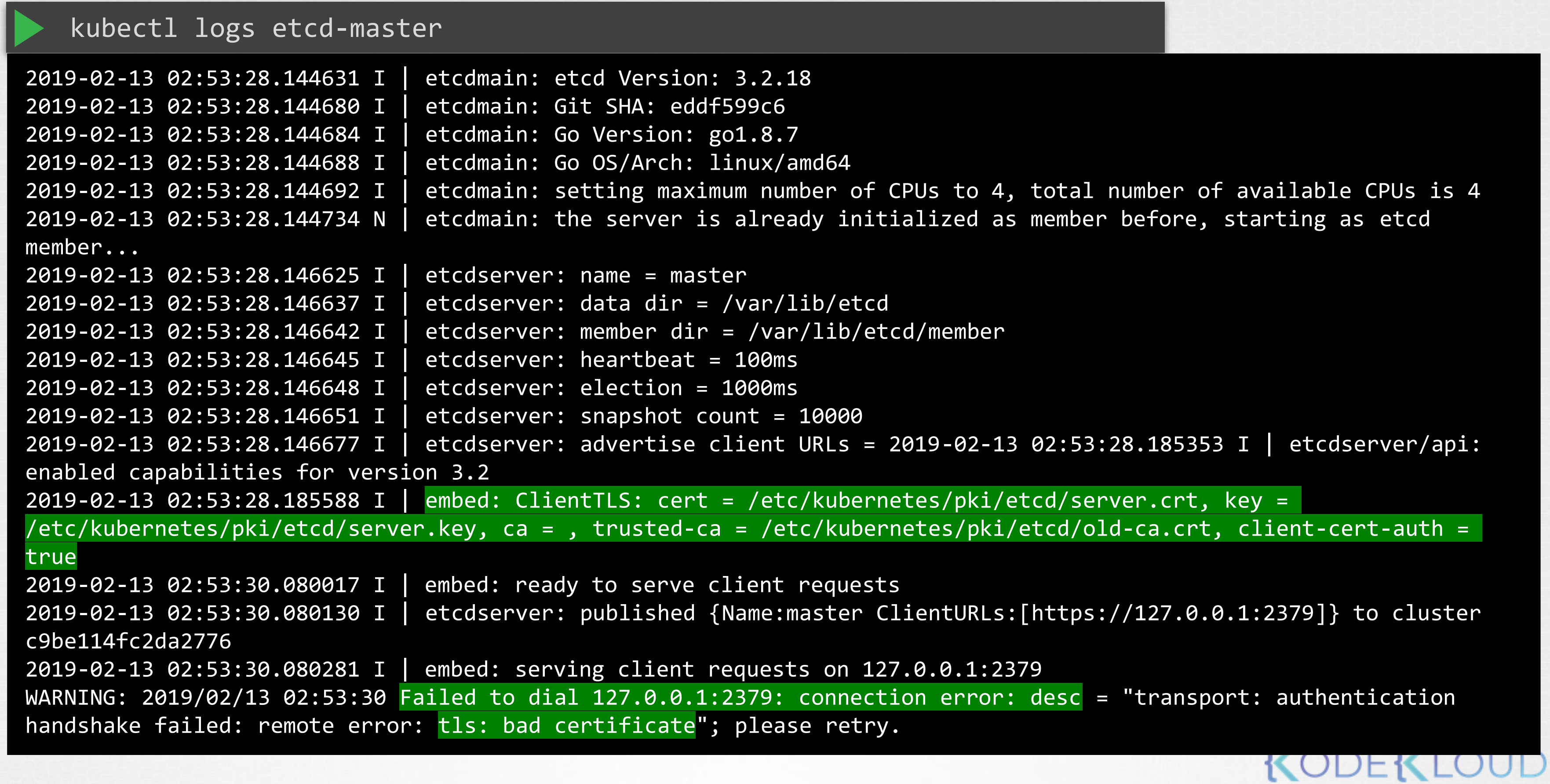
Inspect Service Logs



```
journalctl -u etcd.service -l
```

```
2019-02-13 02:53:28.144631 I | etcdmain: etcd Version: 3.2.18
2019-02-13 02:53:28.144680 I | etcdmain: Git SHA: eddf599c6
2019-02-13 02:53:28.144684 I | etcdmain: Go Version: go1.8.7
2019-02-13 02:53:28.144688 I | etcdmain: Go OS/Arch: linux/amd64
2019-02-13 02:53:28.144692 I | etcdmain: setting maximum number of CPUs to 4, total number of available CPUs is 4
2019-02-13 02:53:28.144734 N | etcdmain: the server is already initialized as member before, starting as etcd
member...
2019-02-13 02:53:28.146625 I | etcdserver: name = master
2019-02-13 02:53:28.146637 I | etcdserver: data dir = /var/lib/etcd
2019-02-13 02:53:28.146642 I | etcdserver: member dir = /var/lib/etcd/member
2019-02-13 02:53:28.146645 I | etcdserver: heartbeat = 100ms
2019-02-13 02:53:28.146648 I | etcdserver: election = 1000ms
2019-02-13 02:53:28.146651 I | etcdserver: snapshot count = 10000
2019-02-13 02:53:28.146677 I | etcdserver: advertise client URLs = 2019-02-13 02:53:28.185353 I | etcdserver/api:
enabled capabilities for version 3.2
2019-02-13 02:53:28.185588 I | embed: ClientTLS: cert = /etc/kubernetes/pki/etcd/server.crt, key =
/etc/kubernetes/pki/etcd/server.key, ca = , trusted-ca = /etc/kubernetes/pki/etcd/old-ca.crt, client-cert-auth =
true
2019-02-13 02:53:30.080017 I | embed: ready to serve client requests
2019-02-13 02:53:30.080130 I | etcdserver: published {Name:master ClientURLs:[https://127.0.0.1:2379]} to cluster
c9be114fc2da2776
2019-02-13 02:53:30.080281 I | embed: serving client requests on 127.0.0.1:2379
WARNING: 2019/02/13 02:53:30 Failed to dial 127.0.0.1:2379: connection error: desc = "transport: authentication
handshake failed: remote error: tls: bad certificate"; please retry.
```

View Logs



```
▶ kubectl logs etcd-master
```

```
2019-02-13 02:53:28.144631 I | etcdmain: etcd Version: 3.2.18
2019-02-13 02:53:28.144680 I | etcdmain: Git SHA: eddf599c6
2019-02-13 02:53:28.144684 I | etcdmain: Go Version: go1.8.7
2019-02-13 02:53:28.144688 I | etcdmain: Go OS/Arch: linux/amd64
2019-02-13 02:53:28.144692 I | etcdmain: setting maximum number of CPUs to 4, total number of available CPUs is 4
2019-02-13 02:53:28.144734 N | etcdmain: the server is already initialized as member before, starting as etcd
member...
2019-02-13 02:53:28.146625 I | etcdserver: name = master
2019-02-13 02:53:28.146637 I | etcdserver: data dir = /var/lib/etcd
2019-02-13 02:53:28.146642 I | etcdserver: member dir = /var/lib/etcd/member
2019-02-13 02:53:28.146645 I | etcdserver: heartbeat = 100ms
2019-02-13 02:53:28.146648 I | etcdserver: election = 1000ms
2019-02-13 02:53:28.146651 I | etcdserver: snapshot count = 10000
2019-02-13 02:53:28.146677 I | etcdserver: advertise client URLs = 2019-02-13 02:53:28.185353 I | etcdserver/api:
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2019-02-13 02:53:28.185588 I | embed: ClientTLS: cert = /etc/kubernetes/pki/etcd/server.crt, key =
/etc/kubernetes/pki/etcd/server.key, ca = , trusted-ca = /etc/kubernetes/pki/etcd/old-ca.crt, client-cert-auth =
true
2019-02-13 02:53:30.080017 I | embed: ready to serve client requests
2019-02-13 02:53:30.080130 I | etcdserver: published {Name:master ClientURLs:[https://127.0.0.1:2379]} to cluster
c9be114fc2da2776
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WARNING: 2019/02/13 02:53:30 Failed to dial 127.0.0.1:2379: connection error: desc = "transport: authentication
handshake failed: remote error: tls: bad certificate"; please retry.
```
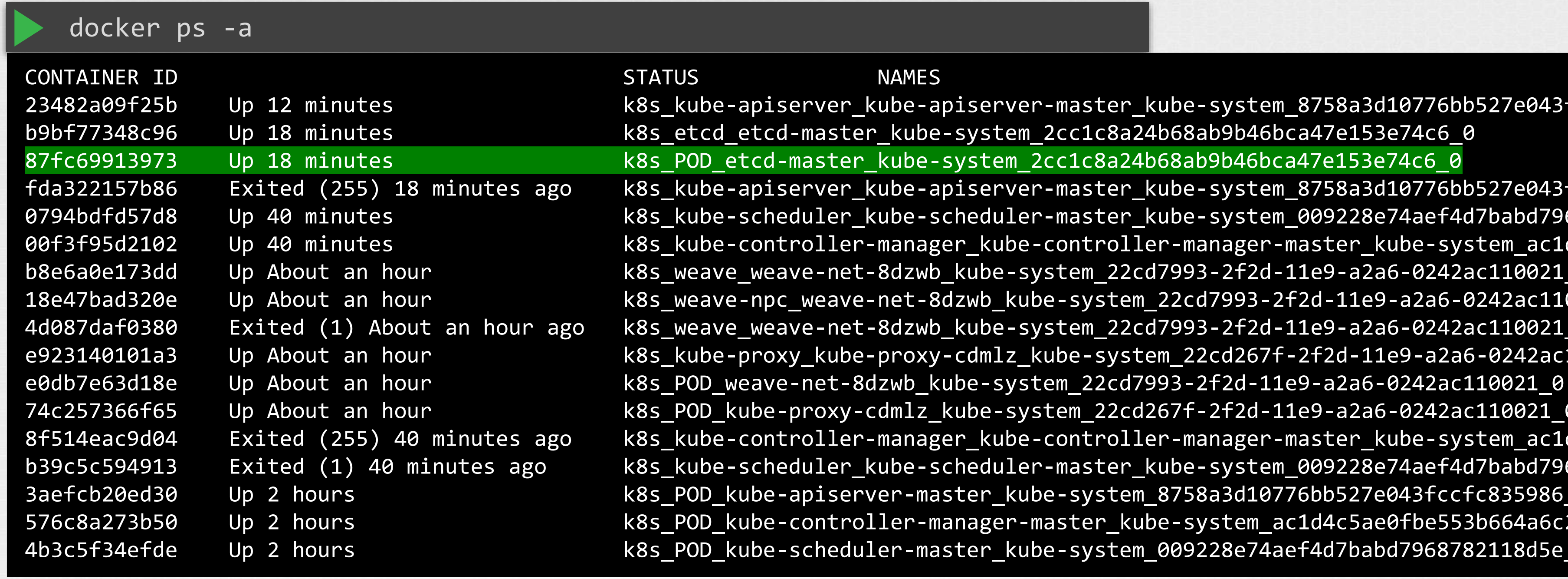
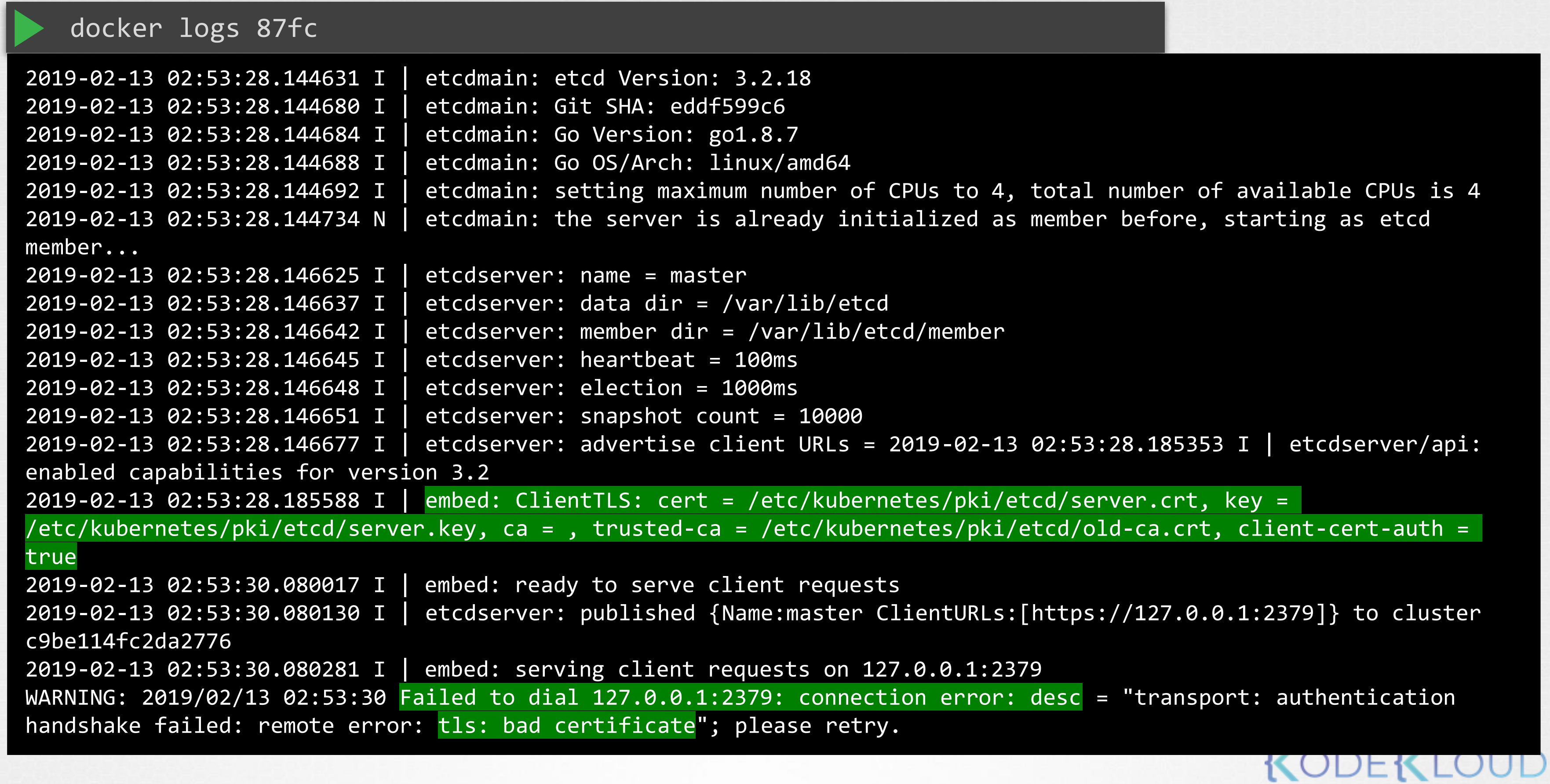

View Logs



```
docker ps -a
```

```
CONTAINER ID                                   STATUS              NAMES
23482a09f25b    Up 12 minutes                  k8s_kube-apiserver_kube-apiserver-master_kube-system_8758a3d10776bb527e043
b9bf77348c96    Up 18 minutes                  k8s_etcd_etcd-master_kube-system_2cc1c8a24b68ab9b46bca47e153e74c6_0
87fc69913973    Up 18 minutes                  k8s_POD_etcd-master_kube-system_2cc1c8a24b68ab9b46bca47e153e74c6_0
fda322157b86    Exited (255) 18 minutes ago    k8s_kube-apiserver_kube-apiserver-master_kube-system_8758a3d10776bb527e043
0794bdfd57d8    Up 40 minutes                  k8s_kube-scheduler_kube-scheduler-master_kube-system_009228e74aef4d7babd79
00f3f95d2102    Up 40 minutes                  k8s_kube-controller-manager_kube-controller-manager-master_kube-system_ac1
b8e6a0e173dd    Up About an hour               k8s_weave_weave-net-8dzwb_kube-system_22cd7993-2f2d-11e9-a2a6-0242ac110021_
18e47bad320e    Up About an hour               k8s_weave-npc_weave-net-8dzwb_kube-system_22cd7993-2f2d-11e9-a2a6-0242ac11
4d087daf0380    Exited (1) About an hour ago   k8s_weave_weave-net-8dzwb_kube-system_22cd7993-2f2d-11e9-a2a6-0242ac110021_
e923140101a3    Up About an hour               k8s_kube-proxy_kube-proxy-cdmlz_kube-system_22cd267f-2f2d-11e9-a2a6-0242ac
e0db7e63d18e    Up About an hour               k8s_POD_weave-net-8dzwb_kube-system_22cd7993-2f2d-11e9-a2a6-0242ac110021_0
74c257366f65    Up About an hour               k8s_POD_kube-proxy-cdmlz_kube-system_22cd267f-2f2d-11e9-a2a6-0242ac110021_
8f514eac9d04    Exited (255) 40 minutes ago    k8s_kube-controller-manager_kube-controller-manager-master_kube-system_ac1
b39c5c594913    Exited (1) 40 minutes ago      k8s_kube-scheduler_kube-scheduler-master_kube-system_009228e74aef4d7babd79
3aefcb20ed30    Up 2 hours                     k8s_POD_kube-apiserver-master_kube-system_8758a3d10776bb527e043fccfc835986
576c8a273b50    Up 2 hours                     k8s_POD_kube-controller-manager-master_kube-system_ac1d4c5ae0fbe553b664a6c
4b3c5f34efde    Up 2 hours                     k8s_POD_kube-scheduler-master_kube-system_009228e74aef4d7babd7968782118d5e
```

View Logs

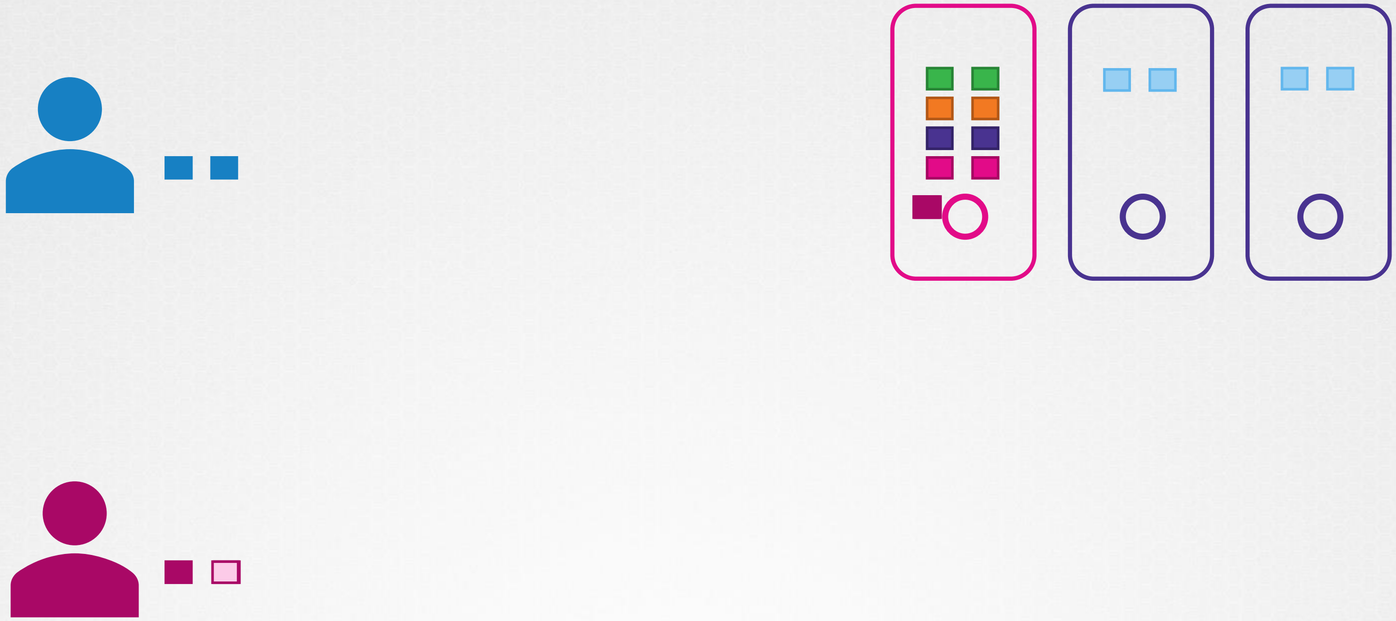


```
docker logs 87fc
```

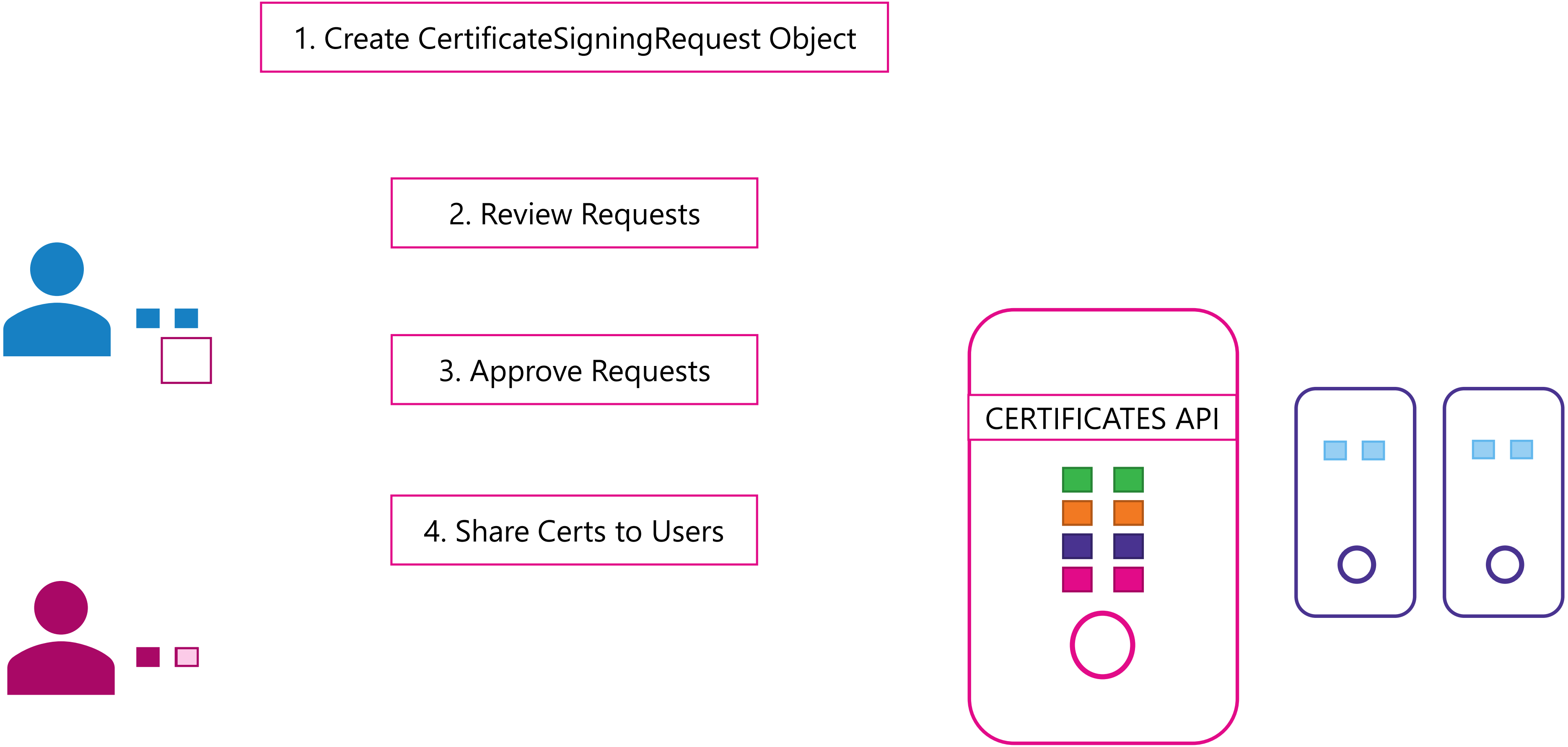
```
2019-02-13 02:53:28.144631 I | etcdmain: etcd Version: 3.2.18
2019-02-13 02:53:28.144680 I | etcdmain: Git SHA: eddf599c6
2019-02-13 02:53:28.144684 I | etcdmain: Go Version: go1.8.7
2019-02-13 02:53:28.144688 I | etcdmain: Go OS/Arch: linux/amd64
2019-02-13 02:53:28.144692 I | etcdmain: setting maximum number of CPUs to 4, total number of available CPUs is 4
2019-02-13 02:53:28.144734 N | etcdmain: the server is already initialized as member before, starting as etcd
member...
2019-02-13 02:53:28.146625 I | etcdserver: name = master
2019-02-13 02:53:28.146637 I | etcdserver: data dir = /var/lib/etcd
2019-02-13 02:53:28.146642 I | etcdserver: member dir = /var/lib/etcd/member
2019-02-13 02:53:28.146645 I | etcdserver: heartbeat = 100ms
2019-02-13 02:53:28.146648 I | etcdserver: election = 1000ms
2019-02-13 02:53:28.146651 I | etcdserver: snapshot count = 10000
2019-02-13 02:53:28.146677 I | etcdserver: advertise client URLs = 2019-02-13 02:53:28.185353 I | etcdserver/api:
enabled capabilities for version 3.2
2019-02-13 02:53:28.185588 I | embed: ClientTLS: cert = /etc/kubernetes/pki/etcd/server.crt, key =
/etc/kubernetes/pki/etcd/server.key, ca = , trusted-ca = /etc/kubernetes/pki/etcd/old-ca.crt, client-cert-auth =
true
2019-02-13 02:53:30.080017 I | embed: ready to serve client requests
2019-02-13 02:53:30.080130 I | etcdserver: published {Name:master ClientURLs:[https://127.0.0.1:2379]} to cluster
c9be114fc2da2776
2019-02-13 02:53:30.080281 I | embed: serving client requests on 127.0.0.1:2379
WARNING: 2019/02/13 02:53:30 Failed to dial 127.0.0.1:2379: connection error: desc = "transport: authentication
handshake failed: remote error: tls: bad certificate"; please retry.
```

TLS CERTIFICATES

Certificate Workflow & API



CERTIFICATE AUTHORITY (CA)

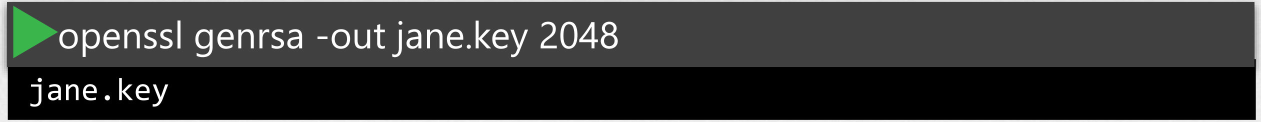


1. Create CertificateSigningRequest Object

2. Review Requests

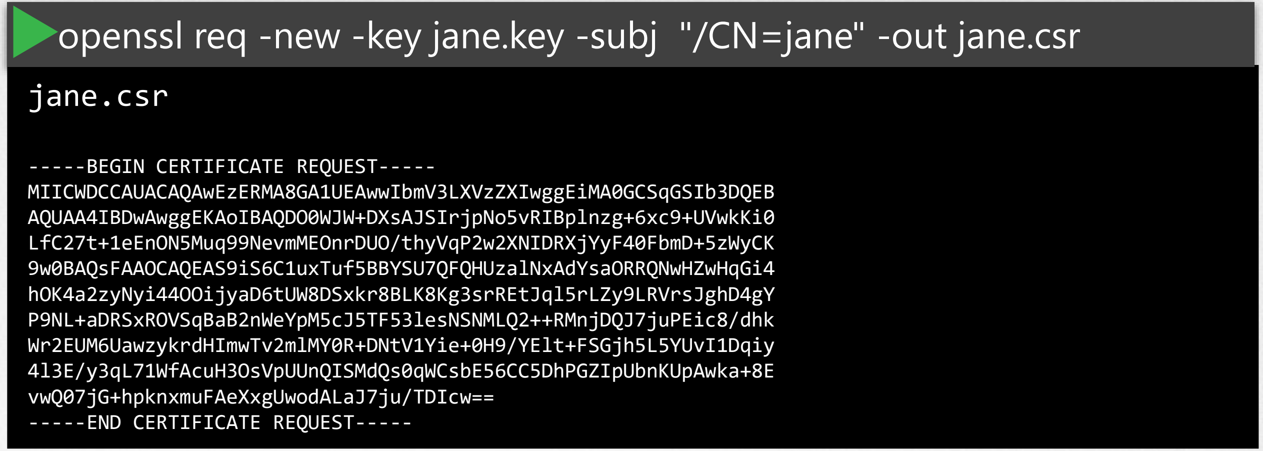
3. Approve Requests

4. Share Certs to Users



```
openssl genrsa -out jane.key 2048
```

```
jane.key
```



```
openssl req -new -key jane.key -subj  "/CN=jane" -out jane.csr
```

```
jane.csr

-----BEGIN CERTIFICATE REQUEST-----
MIICWDCCAUACAQAwEzERMA8GA1UEAwwIbmV3LXVzZXIwggEiMA0GCSqGSIb3DQEB
AQUAA4IBDwAwggEKAoIBAQDO0WJW+DXsAJSIrjpNo5vRIBplnzg+6xc9+UVwkKi0
LfC27t+1eEnON5Muq99NevmMEOnrDUO/thyVqP2w2XNIDRXjYyF40FbmD+5zWyCK
9w0BAQsFAAOCAQEAS9iS6C1uxTuf5BBYSU7QFQHUzalNxAdYsaORRQNwHZwHqGi4
hOK4a2zyNyi44OOijyaD6tUW8DSxkr8BLK8Kg3srREtJql5rLZy9LRVrsJghD4gY
P9NL+aDRSxROVSqBaB2nWeYpM5cJ5TF53lesNSNMLQ2++RMnjDQJ7juPEic8/dhk
Wr2EUM6UawzykrdHImwTv2mlMY0R+DNtV1Yie+0H9/YElt+FSGjh5L5YUvI1Dqiy
4l3E/y3qL71WfAcuH3OsVpUUnQISMdQs0qWCsbE56CC5DhPGZIpUbnKUpAwka+8E
vwQ07jG+hpknxmuFAeXxgUwodALaJ7ju/TDIcw==
-----END CERTIFICATE REQUEST-----
```

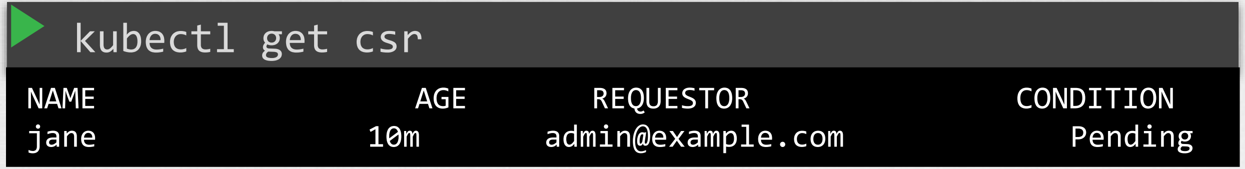
```
jane.csr

-----BEGIN CERTIFICATE REQUEST-----
MIICWDCCAUACAQAwEzERMA8GA1UEAwwIbmV3LXVzZXIwggEiMA0GCSqGSIb3DQEB
AQUAA4IBDwAwggEKAoIBAQDO0WJW+DXsAJSIrjpNo5vRIBplnzg+6xc9+UVwkKi0
LfC27t+1eEnON5Muq99NevmMEOnrDUO/thyVqP2w2XNIDRXjYyF40FbmD+5zWyCK
9w0BAQsFAAOCAQEAS9iS6C1uxTuf5BBYSU7QFQHUzalNxAdYsaORRQNwHZwHqGi4
hOK4a2zyNyi44OOijyaD6tUW8DSxkr8BLK8Kg3srREtJql5rLZy9LRVrsJghD4gY
P9NL+aDRSxROVSqBaB2nWeYpM5cJ5TF53lesNSNMLQ2++RMnjDQJ7juPEic8/dhk
Wr2EUM6UawzykrdHImwTv2mlMY0R+DNtV1Yie+0H9/YElt+FSGjh5L5YUvI1Dqiy
4l3E/y3qL71WfAcuH3OsVpUUnQISMdQs0qWCsbE56CC5DhPGZIpUbnKUpAwka+8E
vwQ07jG+hpknxmuFAeXxgUwodALaJ7ju/TDIcw==
-----END CERTIFICATE REQUEST-----
```

```
cat jane.csr | base64
```

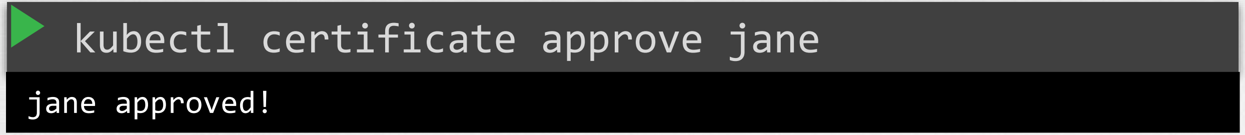
```
LS0tLS1CRUdJTiBDRVJUSUZJQ0FURSBSRVFVRVNULS0
tLS0KTUlJQ1dEQ0NBVUFDQVFBd0V6RVJNQThHQTFVRU
F3d0libVYzTFhwelpYSXdnZ0VpTUEwR0NTcUdTSWIzR
FFFQgpBUVVBQTRJQkR3QXdnZ0VLQW9JQkFRRE8wV0pX
K0RYc0FKU0lyanBObzV2UklCcGxuemcrNnhjOStVVnd
rS2kwCkxmQzI3dCsxZUVuT041TXVxOTl0ZXZtTUVPbn
J
```

jane-csr.yaml

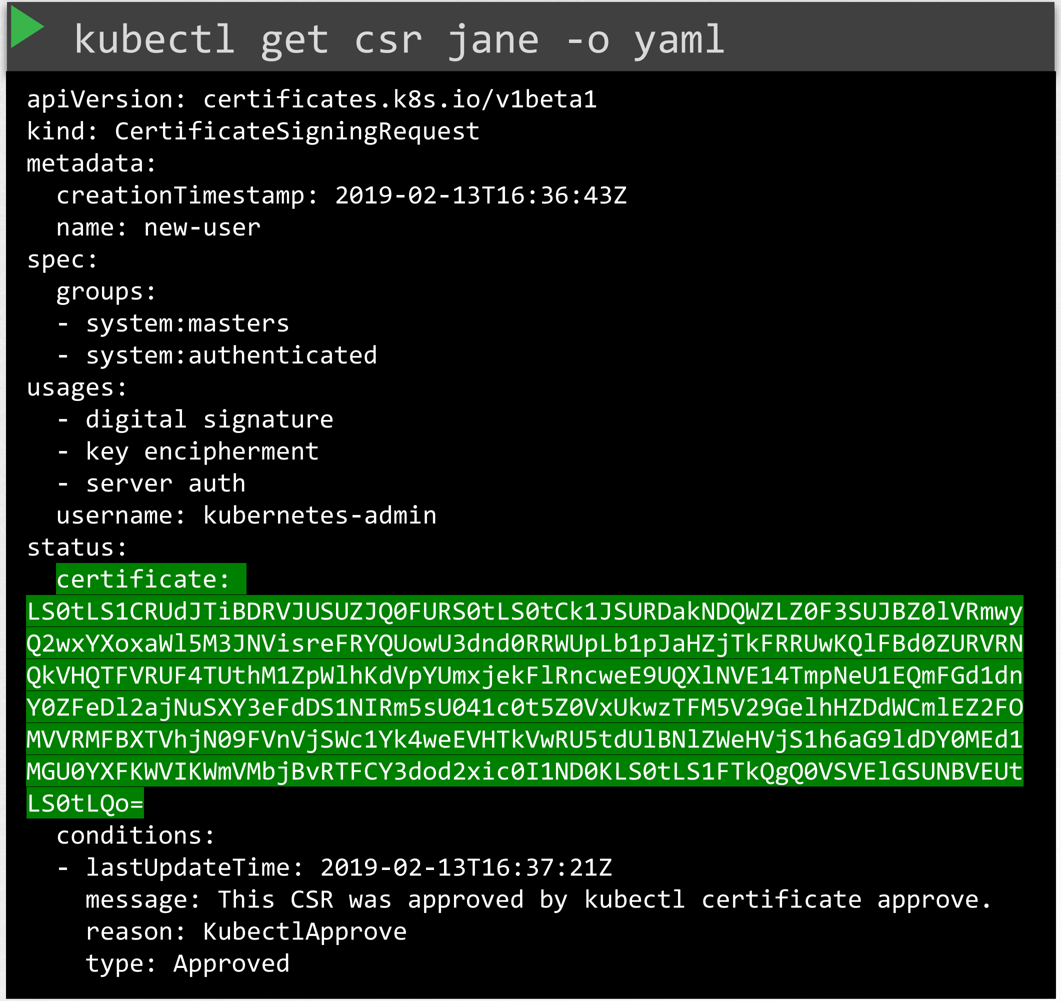
```yaml
apiVersion: certificates.k8s.io/v1beta1
kind: CertificateSigningRequest
metadata:
  name: jane
spec:
  groups:
  - system:authenticated
  usages:
  - digital signature
  - key encipherment
  - server auth
  request:
```



```
▶ kubectl get csr
NAME                 AGE       REQUESTOR                 CONDITION
jane               10m     admin@example.com                Pending
```

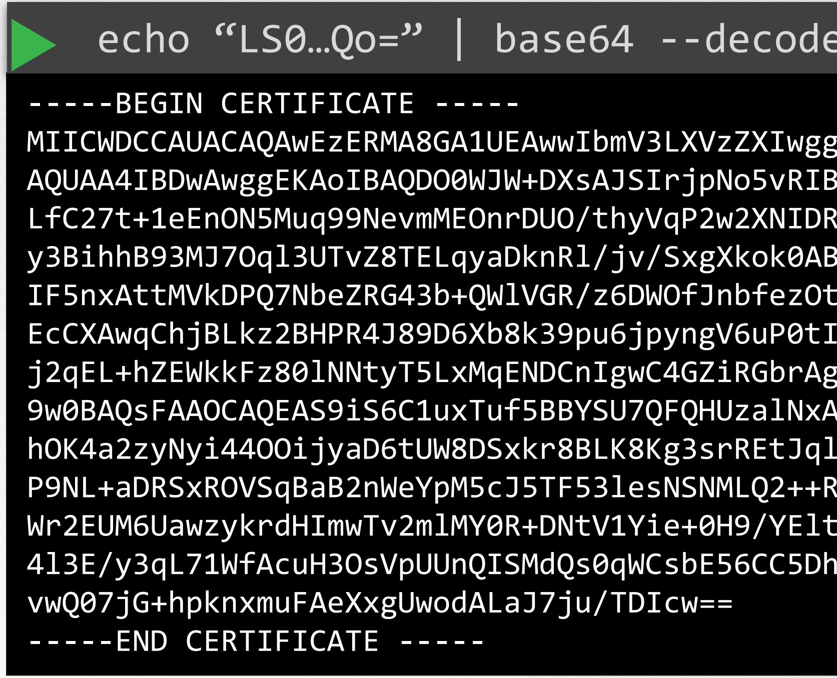


```
▶ kubectl certificate approve jane
jane approved!
```



```
▶ kubectl get csr jane -o yaml
```

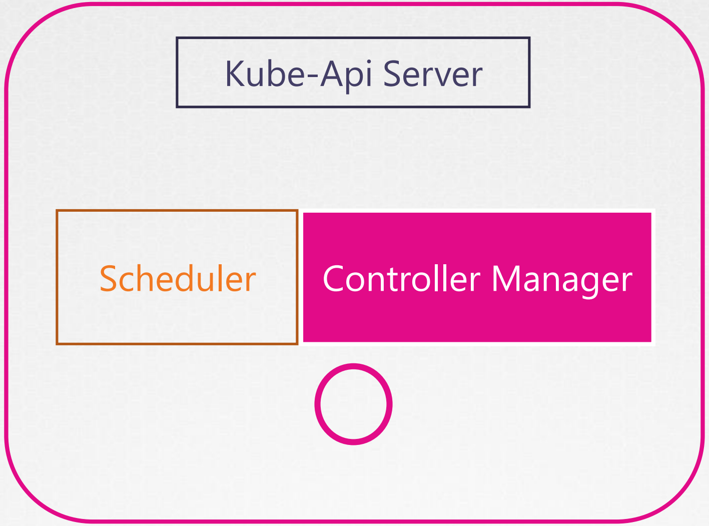
```
apiVersion: certificates.k8s.io/v1beta1
kind: CertificateSigningRequest
metadata:
  creationTimestamp: 2019-02-13T16:36:43Z
  name: new-user
spec:
  groups:
  - system:masters
  - system:authenticated
usages:
  - digital signature
  - key encipherment
  - server auth
  username: kubernetes-admin
status:
  certificate:
LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSURDakNDQWZLZ0F3SUJBZ0lVRmwy
Q2wxYXoxaWl5M3JNVisreFRYQUowU3dnd0RRWUpLb1pJaHZjTkFRRUwKQlFBd0ZURVRN
QkVHQTFVRUF4TUthM1ZpWlhKdVpYUmxjekFlRncweE9UQXlNVE14TmpNeU1EQmFGd1dn
Y0ZFeDl2ajNuSXY3eFdDS1NIRm5sU041c0t5Z0VxUkwzTFM5V29GelhHZDdWCmlEZ2FO
MVVRMFBXTVhjN09FVnVjSWc1Yk4weEVHTkVwRU5tdUlBNlZWeHVjS1h6aG9ldDY0MEd1
MGU0YXFKWVIKWmVMbjBvRTFCY3dod2xic0I1ND0KLS0tLS1FTkQgQ0VSVElGSUNBVEUt
LS0tLQo=
  conditions:
  - lastUpdateTime: 2019-02-13T16:37:21Z
    message: This CSR was approved by kubectl certificate approve.
    reason: KubectlApprove
    type: Approved
```



```
▶ echo “LS0…Qo=” | base64 --decode
```

```
-----BEGIN CERTIFICATE -----
MIICWDCCAUACAQAwEzERMA8GA1UEAwwIbmV3LXVzZXIwgg
AQUAA4IBDwAwggEKAoIBAQDO0WJW+DXsAJSIrjpNo5vRIB
LfC27t+1eEnON5Muq99NevmMEOnrDUO/thyVqP2w2XNIDR
y3BihhB93MJ7Oql3UTvZ8TELqyaDknRl/jv/SxgXkok0AB
IF5nxAttMVkDPQ7NbeZRG43b+QWlVGR/z6DWOfJnbfezOt
EcCXAwqChjBLkz2BHPR4J89D6Xb8k39pu6jpyngV6uP0tI
j2qEL+hZEWkkFz80lNNtyT5LxMqENDCnIgwC4GZiRGbrAg
9w0BAQsFAAOCAQEAS9iS6C1uxTuf5BBYSU7QFQHUzalNxA
hOK4a2zyNyi44OOijyaD6tUW8DSxkr8BLK8Kg3srREtJql
P9NL+aDRSxROVSqBaB2nWeYpM5cJ5TF53lesNSNMLQ2++R
Wr2EUM6UawzykrdHImwTv2mlMY0R+DNtV1Yie+0H9/YElt
4l3E/y3qL71WfAcuH3OsVpUUnQISMdQs0qWCsbE56CC5Dh
vwQ07jG+hpknxmuFAeXxgUwodALaJ7ju/TDIcw==
-----END CERTIFICATE -----
```

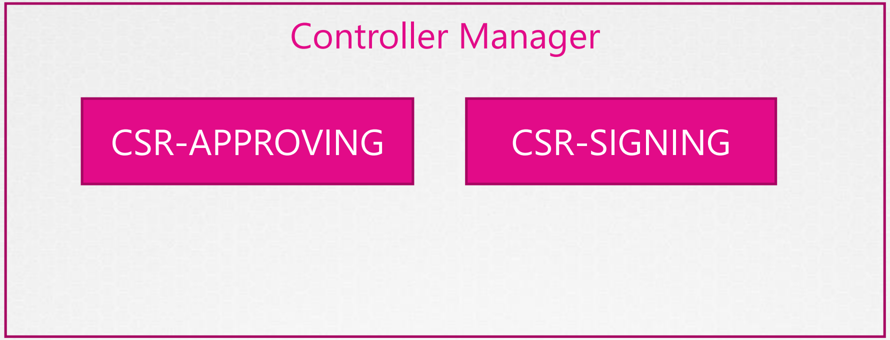
KODEKLOUD



Kube-Api Server

Scheduler

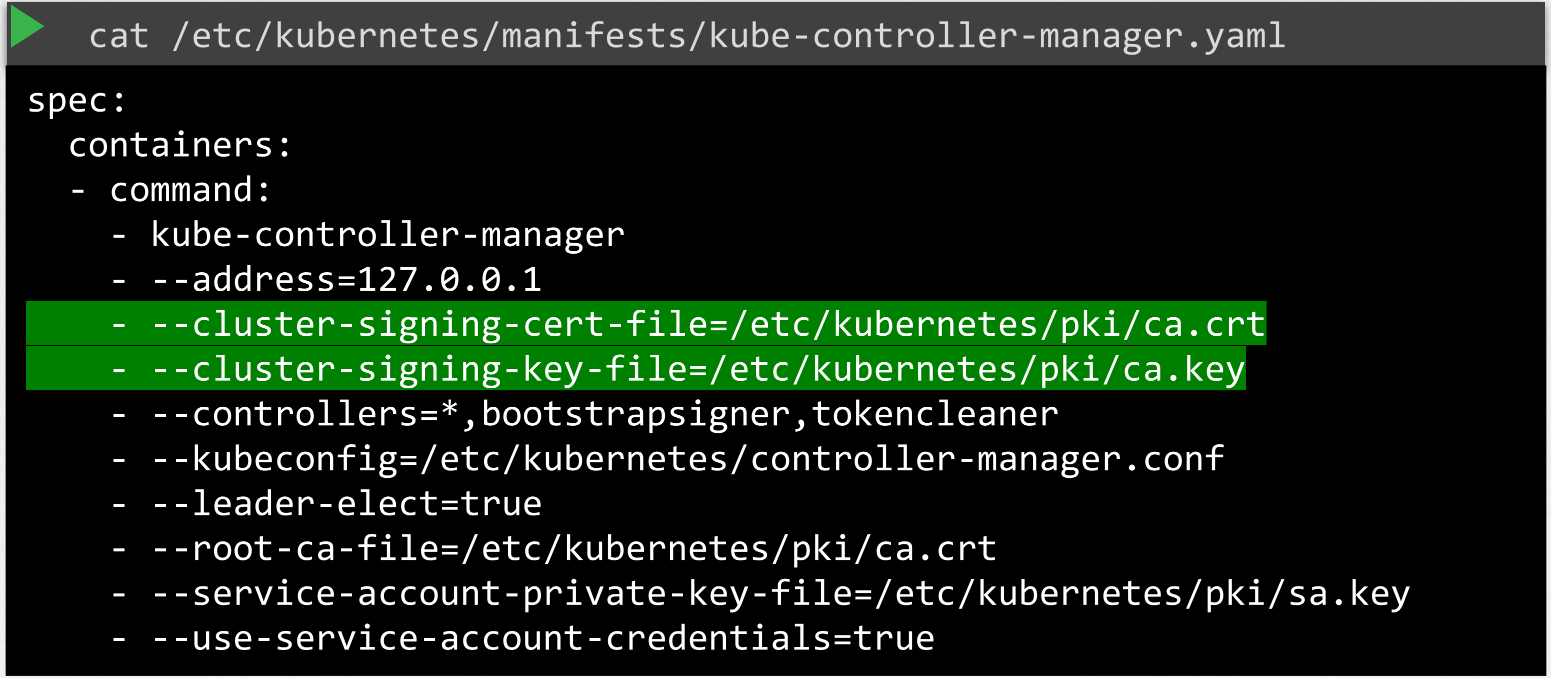
Controller Manager



Controller Manager

CSR-APPROVING

CSR-SIGNING



```
cat /etc/kubernetes/manifests/kube-controller-manager.yaml
```

```
spec:
  containers:
  - command:
    - kube-controller-manager
    - --address=127.0.0.1
    - --cluster-signing-cert-file=/etc/kubernetes/pki/ca.crt
    - --cluster-signing-key-file=/etc/kubernetes/pki/ca.key
    - --controllers=*,bootstrapsigner,tokencleaner
    - --kubeconfig=/etc/kubernetes/controller-manager.conf
    - --leader-elect=true
    - --root-ca-file=/etc/kubernetes/pki/ca.crt
    - --service-account-private-key-file=/etc/kubernetes/pki/sa.key
    - --use-service-account-credentials=true
```

Client Certificates for Clients

kube-scheduler

kube-controller-manager

- CA CERT for Cluster Signing
- CA KEY for Cluster Signing
- CA CERT
- KEY for SERVICE ACCOUNT

kubelet

kube-proxy

Server Certificates for Servers

kube-apiserver

Kube-api.service

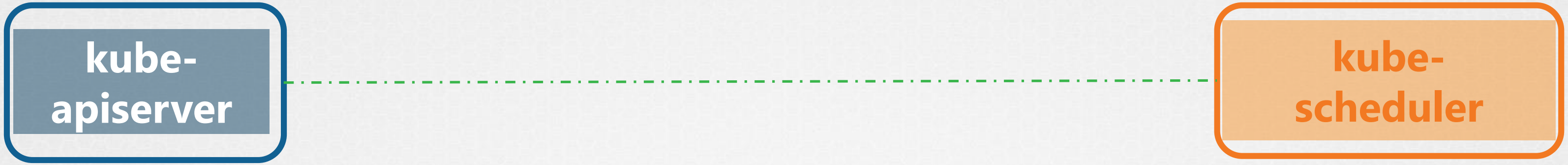
- CA CERT for ETCD
- CERT for ETCD
- KEY for ETCD
- CA CERT for KUBELET
- CERT for KUBELET CLIE
- KEY for KUBELET CLIEN
- CERT for Service Accou
- CERT for TLS
- KEY for TLS

kubelet

Kubelet-config.yaml

- tlsCertFile
- tlsPrivateKeyFile

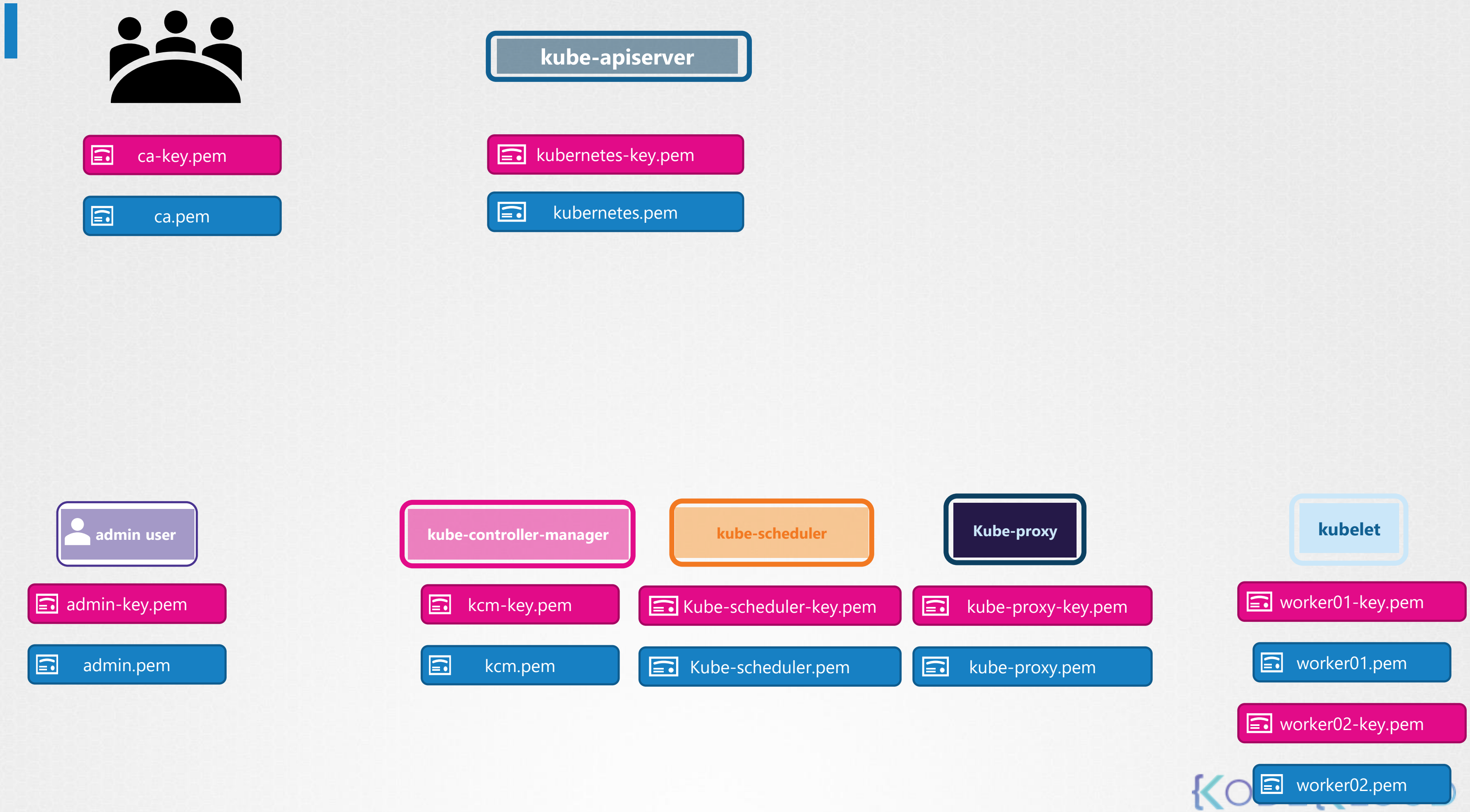
ETCD CLUSTER



kube-apiserver

kube-scheduler

Provision Certificate Authority



ca-key.pem

ca.pem

kube-apiserver

kubernetes-key.pem

kubernetes.pem

admin user

admin-key.pem

admin.pem

kube-controller-manager

kcm-key.pem

kcm.pem

kube-scheduler

Kube-scheduler-key.pem

Kube-scheduler.pem

Kube-proxy

kube-proxy-key.pem

kube-proxy.pem

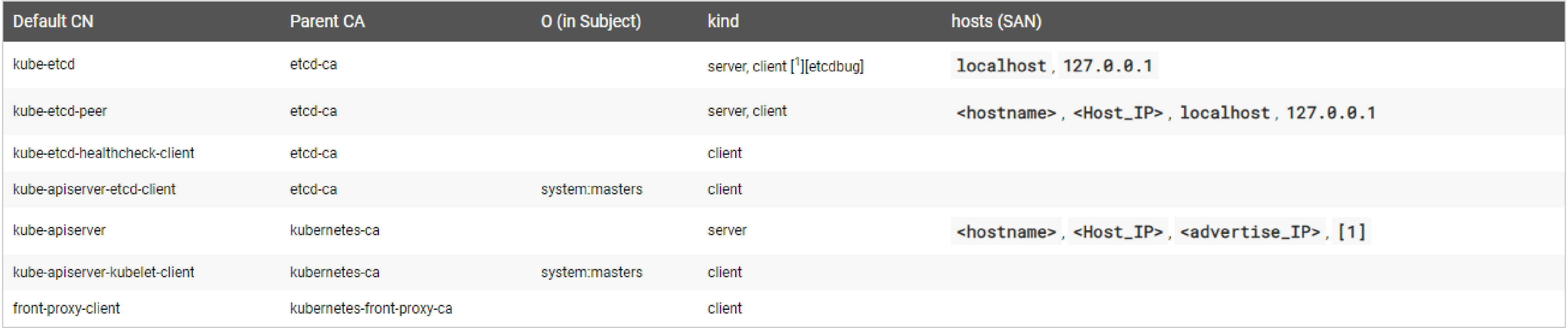
kubelet

worker01-key.pem

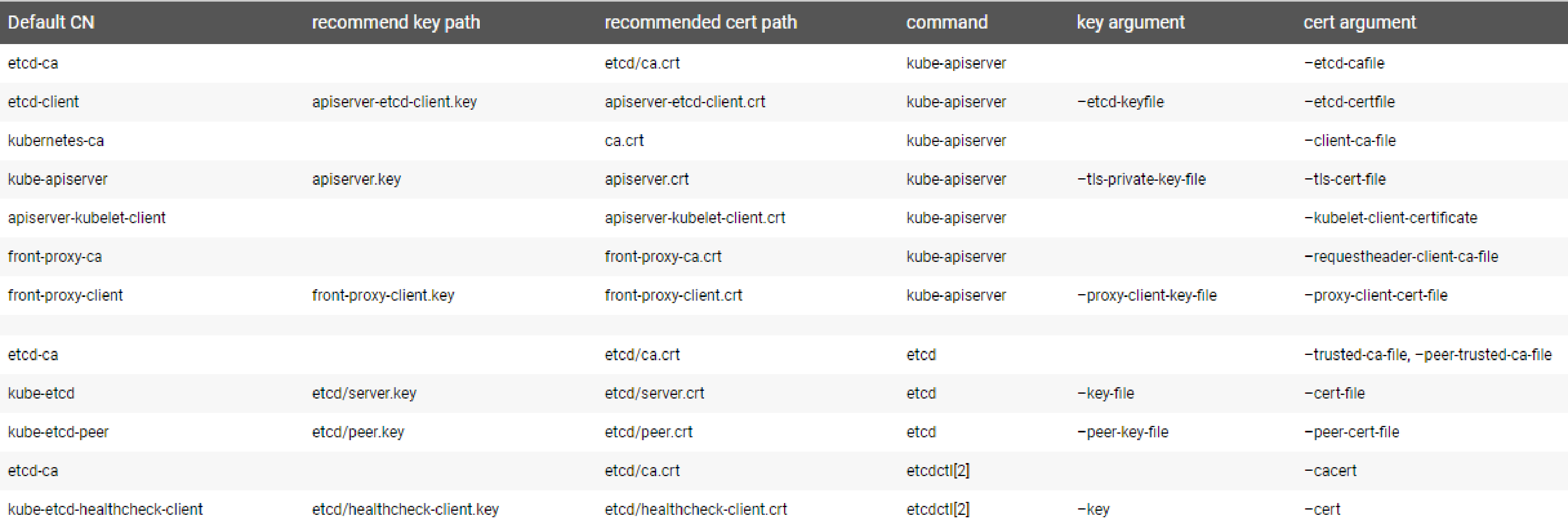
worker01.pem

worker02-key.pem

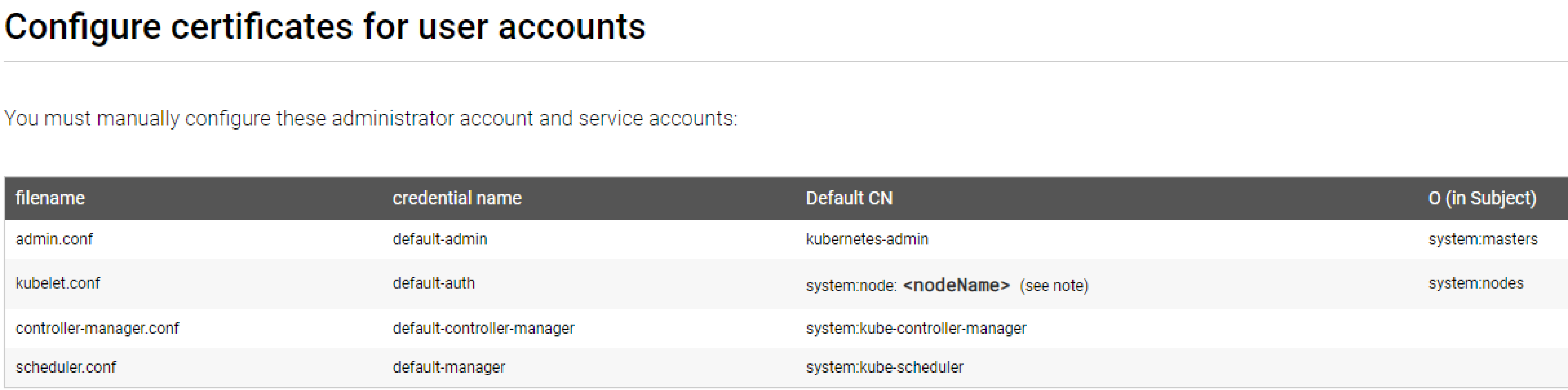
worker02.pem



Default CN	Parent CA	O (in Subject)	kind	hosts (SAN)
kube-etcd	etcd-ca		server, client [1][etcdbug]	`localhost`, `127.0.0.1`
kube-etcd-peer	etcd-ca		server, client	`<hostname>`, `<Host_IP>`, `localhost`, `127.0.0.1`
kube-etcd-healthcheck-client	etcd-ca		client	
kube-apiserver-etcd-client	etcd-ca	system:masters	client	
kube-apiserver	kubernetes-ca		server	`<hostname>`, `<Host_IP>`, `<advertise_IP>`, `[1]`
kube-apiserver-kubelet-client	kubernetes-ca	system:masters	client	
front-proxy-client	kubernetes-front-proxy-ca		client	



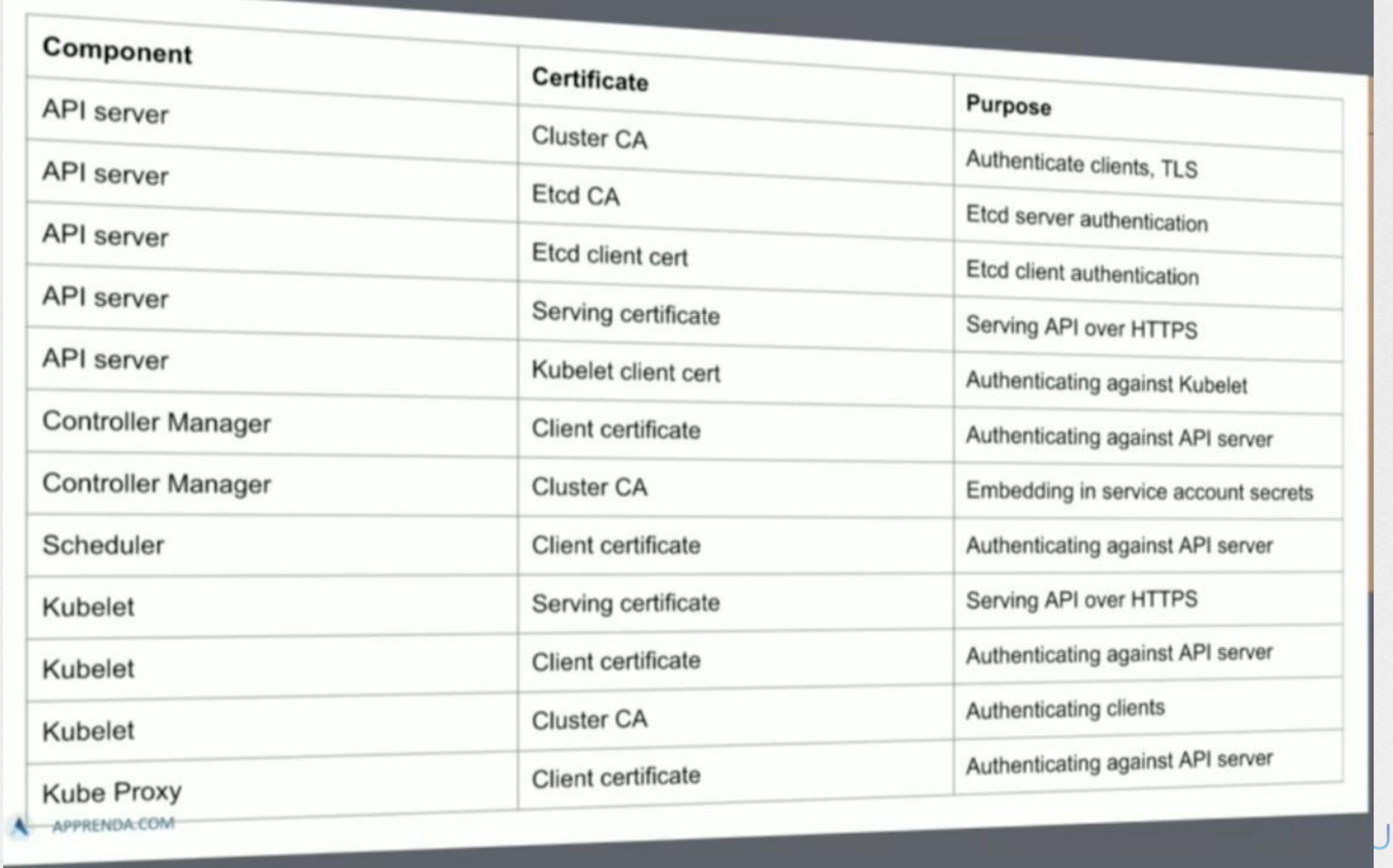
Default CN	recommend key path	recommended cert path	command	key argument	cert argument
etcd-ca		etcd/ca.crt	kube-apiserver		−etcd-cafile
etcd-client	apiserver-etcd-client.key	apiserver-etcd-client.crt	kube-apiserver	−etcd-keyfile	−etcd-certfile
kubernetes-ca		ca.crt	kube-apiserver		−client-ca-file
kube-apiserver	apiserver.key	apiserver.crt	kube-apiserver	−tls-private-key-file	−tls-cert-file
apiserver-kubelet-client		apiserver-kubelet-client.crt	kube-apiserver		−kubelet-client-certificate
front-proxy-ca		front-proxy-ca.crt	kube-apiserver		−requestheader-client-ca-file
front-proxy-client	front-proxy-client.key	front-proxy-client.crt	kube-apiserver	−proxy-client-key-file	−proxy-client-cert-file
etcd-ca		etcd/ca.crt	etcd		−trusted-ca-file, −peer-trusted-ca-file
kube-etcd	etcd/server.key	etcd/server.crt	etcd	−key-file	−cert-file
kube-etcd-peer	etcd/peer.key	etcd/peer.crt	etcd	−peer-key-file	−peer-cert-file
etcd-ca		etcd/ca.crt	etcdctl[2]		−cacert
kube-etcd-healthcheck-client	etcd/healthcheck-client.key	etcd/healthcheck-client.crt	etcdctl[2]	−key	−cert



Configure certificates for user accounts

You must manually configure these administrator account and service accounts:

filename	credential name	Default CN	O (in Subject)
admin.conf	default-admin	kubernetes-admin	system:masters
kubelet.conf	default-auth	system:node: `<nodeName>` (see note)	system:nodes
controller-manager.conf	default-controller-manager	system:kube-controller-manager	
scheduler.conf	default-manager	system:kube-scheduler	



Component	Certificate	Purpose
API server	Cluster CA	Authenticate clients, TLS
API server	Etcd CA	Etcd server authentication
API server	Etcd client cert	Etcd client authentication
API server	Serving certificate	Serving API over HTTPS
API server	Kubelet client cert	Authenticating against Kubelet
Controller Manager	Client certificate	Authenticating against API server
Controller Manager	Cluster CA	Embedding in service account secrets
Scheduler	Client certificate	Authenticating against API server
Kubelet	Serving certificate	Serving API over HTTPS
Kubelet	Client certificate	Authenticating against API server
Kubelet	Cluster CA	Authenticating clients
Kube Proxy	Client certificate	Authenticating against API server

APPRENDA.COM

```
- kube-apiserver
  - --authorization-mode=Node,RBAC
  - --advertise-address=172.17.0.18
  - --allow-privileged=true
  - --client-ca-file=/etc/kubernetes/pki/ca.crt
  - --disable-admission-plugins=PersistentVolumeLabel
  - --enable-admission-plugins=NodeRestriction
  - --enable-bootstrap-token-auth=true
  - --etcd-cafile=/etc/kubernetes/pki/etcd/ca.crt
  - --etcd-certfile=/etc/kubernetes/pki/apiserver-etcd-client.crt
  - --etcd-keyfile=/etc/kubernetes/pki/apiserver-etcd-client.key
  - --etcd-servers=https://127.0.0.1:2379
  - --insecure-port=0
  - --kubelet-client-certificate=/etc/kubernetes/pki/apiserver-kubelet-client.crt
  - --kubelet-client-key=/etc/kubernetes/pki/apiserver-kubelet-client.key
  - --kubelet-preferred-address-types=InternalIP,ExternalIP,Hostname
  - --proxy-client-cert-file=/etc/kubernetes/pki/front-proxy-client.crt
  - --proxy-client-key-file=/etc/kubernetes/pki/front-proxy-client.key
  - --requestheader-allowed-names=front-proxy-client
  - --requestheader-client-ca-file=/etc/kubernetes/pki/front-proxy-ca.crt
  - --requestheader-extra-headers-prefix=X-Remote-Extra-
  - --requestheader-group-headers=X-Remote-Group
  - --requestheader-username-headers=X-Remote-User
  - --secure-port=6443
  - --service-account-key-file=/etc/kubernetes/pki/sa.pub
  - --service-cluster-ip-range=10.96.0.0/12
  - --tls-cert-file=/etc/kubernetes/pki/apiserver.crt
  - --tls-private-key-file=/etc/kubernetes/pki/apiserver.key
```

```
openssl genrsa -out old-ca.key 2048
openssl req -new -key old-ca.key -subj "/CN=old-ca" -out old-ca.csr
openssl x509 -req -in old-ca.csr -signkey old-ca.key -out old-ca.crt -days 365

openssl x509 -req -in ca.csr -signkey ca.key -out server.crt -days 365

openssl req -new -key apiserver-kubelet-client.key -out apiserver-kubelet-client.csr -subj "/CN=kube-apiserver-kubelet-client/O=system:masters"

openssl req -new -key apiserver-kubelet-client.key -out apiserver-kubelet-client.csr -subj "/CN=kube-apiserver-kubelet-client/O=system:masters"
openssl x509 -req -in apiserver-kubelet-client.csr -CA /root/new-ca/old-ca.crt -CAkey /root/new-ca/old-ca.key -CAcreateserial -out apiserver-kubelet-client-new.crt -days 365


openssl req -new -key apiserver-etcd-client.key -out apiserver-etcd-client.csr -subj "/CN=kube-apiserver-etcd-client/O=system:masters"
openssl x509 -req -in apiserver-etcd-client.csr -CA /root/new-ca/old-ca.crt -CAkey /root/new-ca/old-ca.key -CAcreateserial -out apiserver-etcd-client-new.crt -days 365


openssl req -new -key apiserver-etcd-client.key -out apiserver-etcd-client.csr -subj "/CN=kube-apiserver-etcd-client/O=system:masters"
openssl x509 -req -in apiserver-etcd-client.csr -CA /root/new-ca/old-ca.crt -CAkey /root/new-ca/old-ca.key -CAcreateserial -out apiserver-etcd-client-new.crt -days 365


openssl req -new -key /etc/kubernetes/pki/apiserver-etcd-client.key -out apiserver-etcd-client.csr -subj "/CN=kube-apiserver-etcd-client/O=system:masters"

openssl x509 -req -in apiserver-etcd-client.csr -CA ca.crt -CAkey ca.key -CAcreateserial -out apiserver-etcd-client.crt -days -10

openssl x509 -req -in apiserver-etcd-client.csr -CA ca.crt -CAkey ca.key -CAcreateserial -out apiserver-etcd-client.crt -startdate 190101010101Z

20170101000000Z
200801010000Z


"openssl", "req", "-new", "-key" ,"/etc/kubernetes/pki/apiserver-etcd-client.key", "-out", "/etc/kubernetes/pki/apiserver-etcd-client.csr", "-subj", "/CN=kube-apiserver-etcd-client/O=system:masters"

"openssl", "x509", "-req", "-in", "/etc/kubernetes/pki/apiserver-etcd-client.csr", "-CA", "/etc/kubernetes/pki/etcd/ca.crt", "-CAkey", "/etc/kubernetes/pki/etcd/ca.key", "-CAcreateserial", "-out", "/etc/kubernetes/pki/apiserver-etcd-client.crt"

openssl x509 -req -in /etc/kubernetes/pki/apiserver-etcd-client.csr -CA /etc/kubernetes/pki/etcd/ca.crt -CAkey /etc/kubernetes/pki/etcd/ca.key -CAcreateserial -out /etc/kubernetes/pki/apiserver-etcd-client.crt -days 100


openssl x509 -req -in apiserver.csr -CA ca.crt -CAkey ca.key -CAcreateserial -out apiserver.crt
```

KODEKLOUD

Security
KUBECONFIG

```
curl https://my-kube-playground:6443/api/v1/pods \
  --key admin.key
  --cert admin.crt
  --cacert ca.crt
```

```
{
  "kind": "PodList",
  "apiVersion": "v1",
  "metadata": {
    "selfLink": "/api/v1/pods",
  },
  "items": []
}
```

```
kubectl get pods
      --server my-kube-playground:6443
      --client-key admin.key
      --client-certificate admin.crt
      --certificate-authority ca.crt
```

```
No resources found.
```

config

$HOME/.kube/config

KubeConfig File

```
--server my-kube-playground:6443
--client-key admin.key
--client-certificate admin.crt
--certificate-authority ca.crt
```

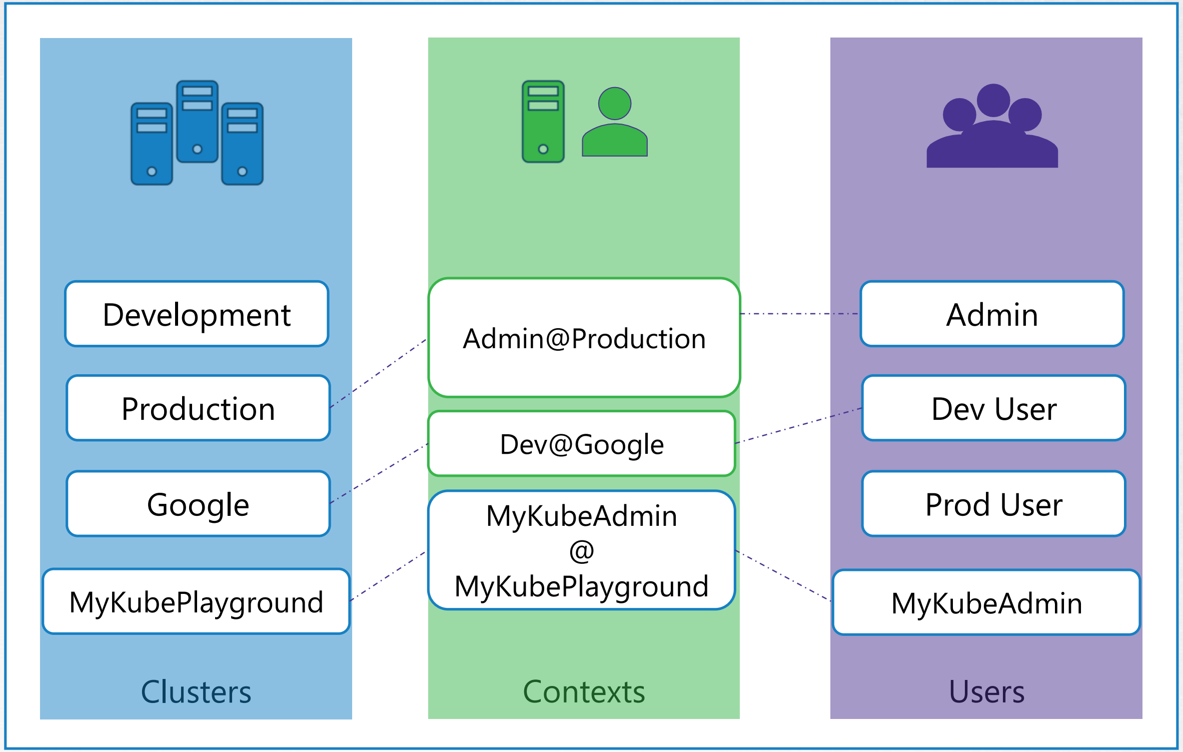
```
kubectl get pods
   --kubeconfig config
```

```
No resources found.
```

KubeConfig File

$HOME/.kube/config

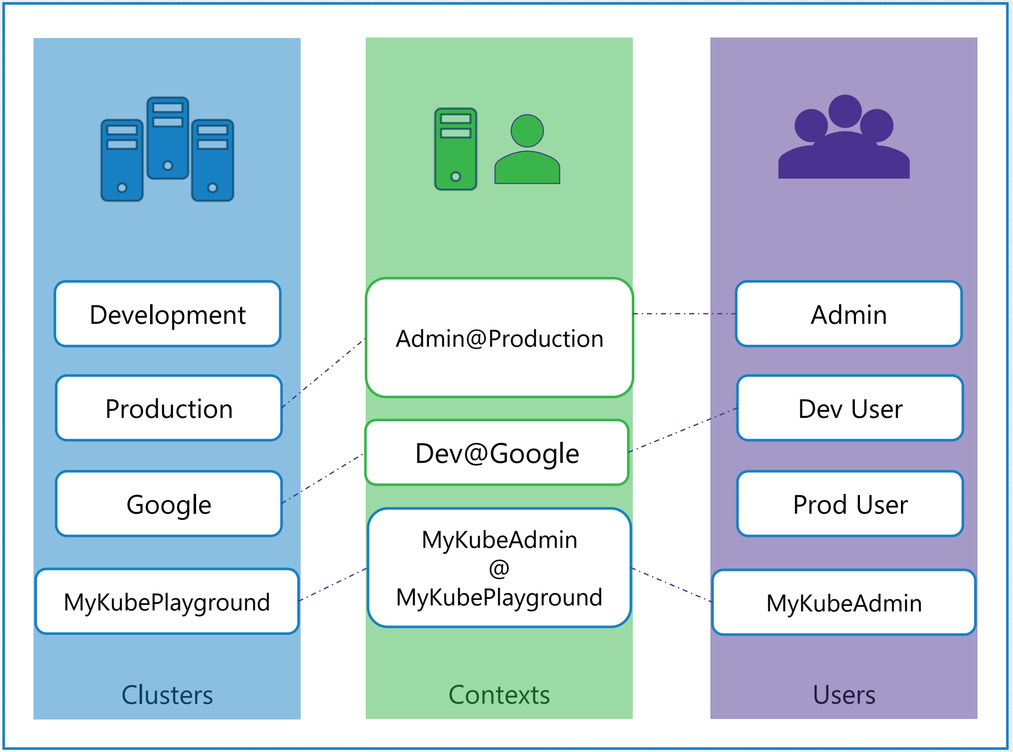
```
--server my-kube-playground:6443
--client-key admin.key
--client-certificate admin.crt
--certificate-authority ca.crt
```



KubeConfig File

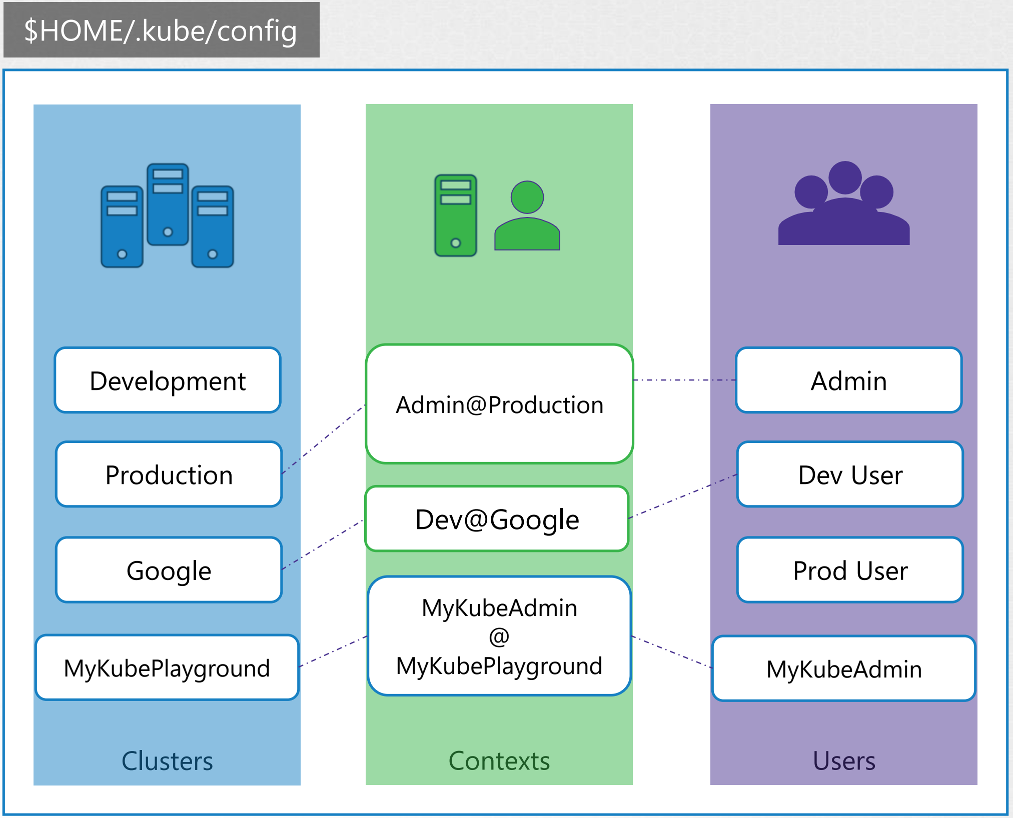
```yaml
apiVersion: v1
kind: Config

clusters:

- name: my-kube-playground
  cluster:
    certificate-authority: ca.crt
    server: https://my-kube-playground:6443


contexts:

- name: my-kube-admin@my-kube-playground
  context:
    cluster:
    user:



users:

- name: my-kube-admin
  user:
    client-certificate: admin.crt
    client-key: admin.key
```

$HOME/.kube/config

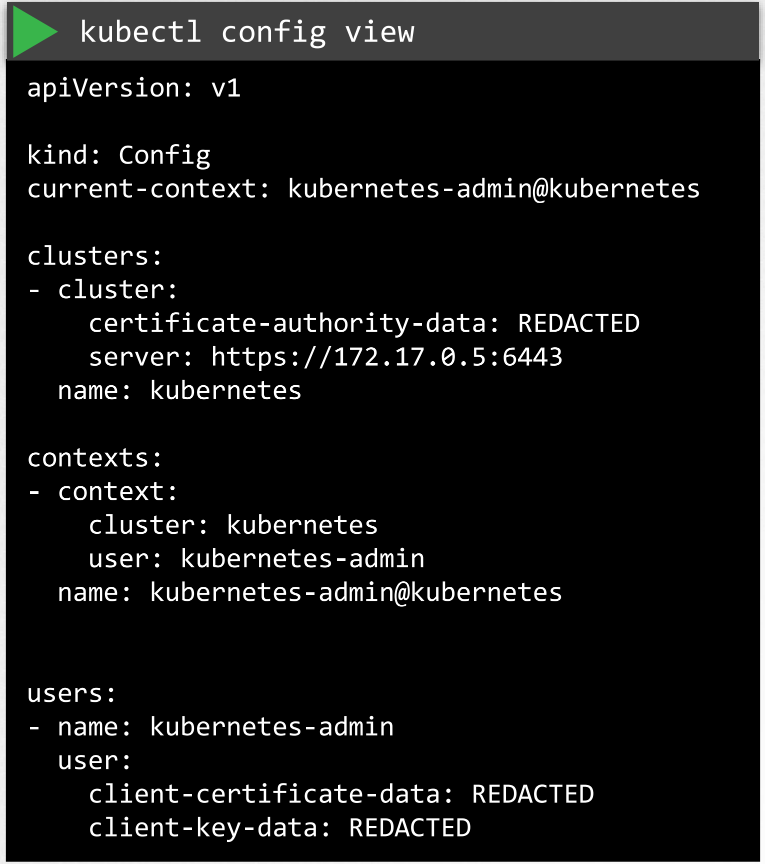


KubeConfig File

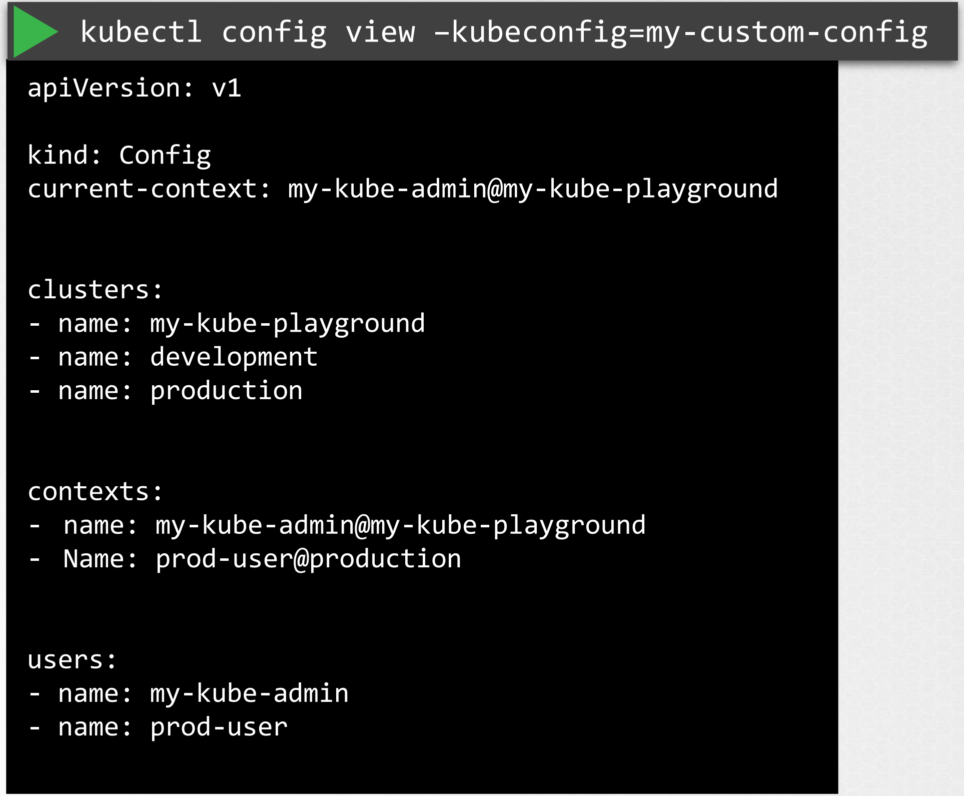
```
apiVersion: v1
kind: Config
current-context: dev-user@google

clusters:
- name: my-kube-playground   (values hidden…)
- name: development
- name: production
- name: google

contexts:
- name: my-kube-admin@my-kube-playground
- name: dev-user@google
- name: prod-user@production

users:
- name: my-kube-admin
- name: admin
- name: dev-user
- name: prod-user
```



Kubectl config

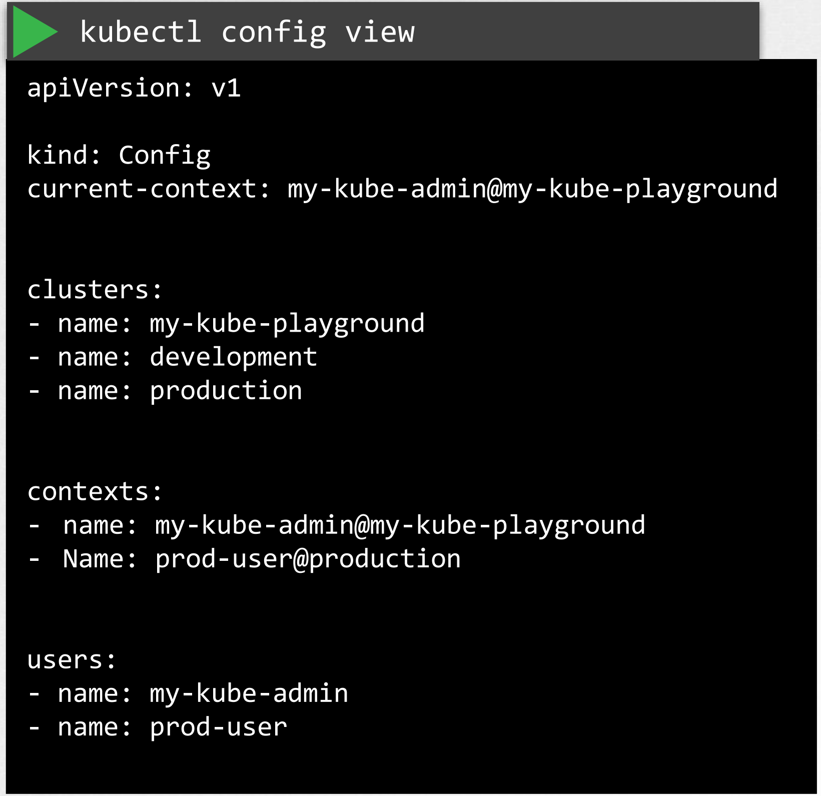


```
▶ kubectl config view
apiVersion: v1

kind: Config
current-context: kubernetes-admin@kubernetes

clusters:
- cluster:
    certificate-authority-data: REDACTED
    server: https://172.17.0.5:6443
  name: kubernetes

contexts:
- context:
    cluster: kubernetes
    user: kubernetes-admin
  name: kubernetes-admin@kubernetes


users:
- name: kubernetes-admin
  user:
    client-certificate-data: REDACTED
    client-key-data: REDACTED
```



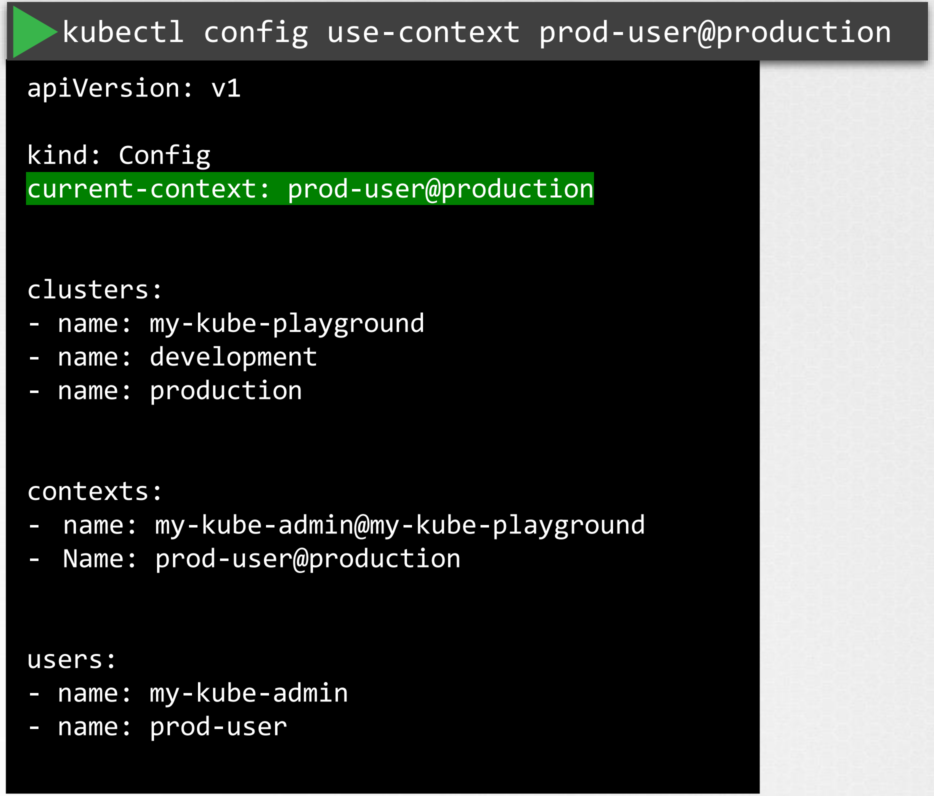
```
▶ kubectl config view –kubeconfig=my-custom-config
apiVersion: v1

kind: Config
current-context: my-kube-admin@my-kube-playground


clusters:
- name: my-kube-playground
- name: development
- name: production


contexts:
-  name: my-kube-admin@my-kube-playground
-  Name: prod-user@production


users:
- name: my-kube-admin
- name: prod-user
```

Kubectl config



```
kubectl config view
```

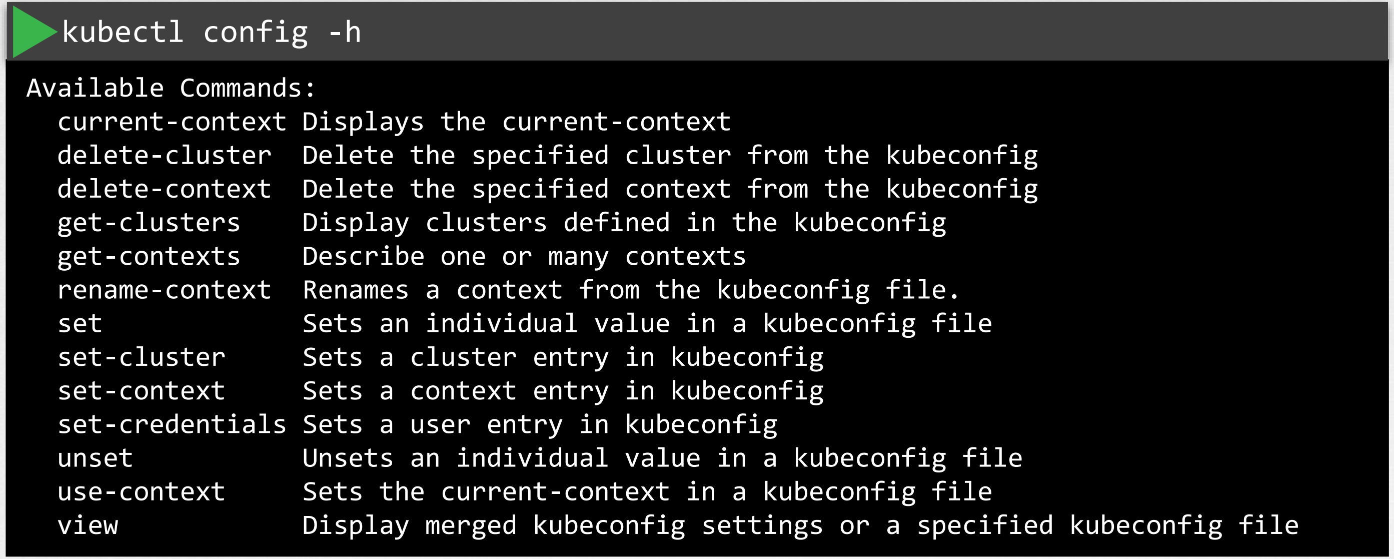
```
apiVersion: v1

kind: Config
current-context: my-kube-admin@my-kube-playground


clusters:
- name: my-kube-playground
- name: development
- name: production


contexts:
-  name: my-kube-admin@my-kube-playground
-  Name: prod-user@production


users:
- name: my-kube-admin
- name: prod-user
```



```
kubectl config use-context prod-user@production
```

```
apiVersion: v1

kind: Config
current-context: prod-user@production


clusters:
- name: my-kube-playground
- name: development
- name: production


contexts:
-  name: my-kube-admin@my-kube-playground
-  Name: prod-user@production


users:
- name: my-kube-admin
- name: prod-user
```

Kubectl config



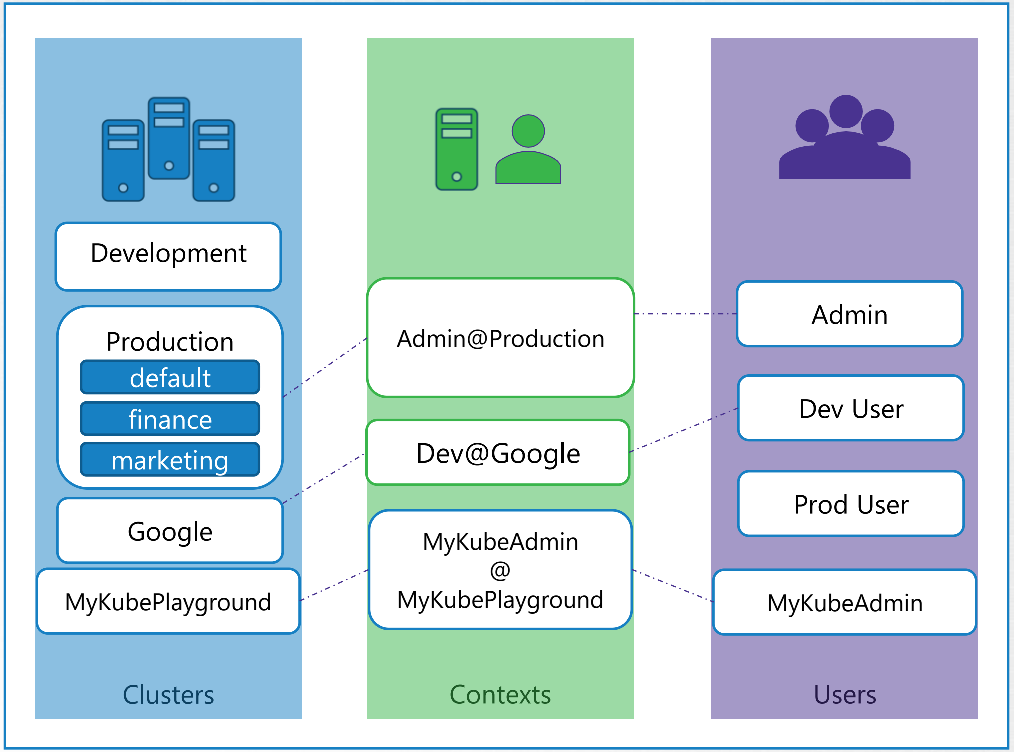
```
▶ kubectl config -h
```

```
Available Commands:
  current-context Displays the current-context
  delete-cluster  Delete the specified cluster from the kubeconfig
  delete-context  Delete the specified context from the kubeconfig
  get-clusters    Display clusters defined in the kubeconfig
  get-contexts    Describe one or many contexts
  rename-context  Renames a context from the kubeconfig file.
  set             Sets an individual value in a kubeconfig file
  set-cluster     Sets a cluster entry in kubeconfig
  set-context     Sets a context entry in kubeconfig
  set-credentials Sets a user entry in kubeconfig
  unset           Unsets an individual value in a kubeconfig file
  use-context     Sets the current-context in a kubeconfig file
  view            Display merged kubeconfig settings or a specified kubeconfig file
```

Namespaces

```
apiVersion: v1
kind: Config

clusters:
- name: production
  cluster:
    certificate-authority: ca.crt
    server: https://172.17.0.51:6443

contexts:
- name: admin@production
  context:
    cluster: production
    user: admin
    namespace: finance

users:
- name: admin
  user:
    client-certificate: admin.crt
    client-key: admin.key
```

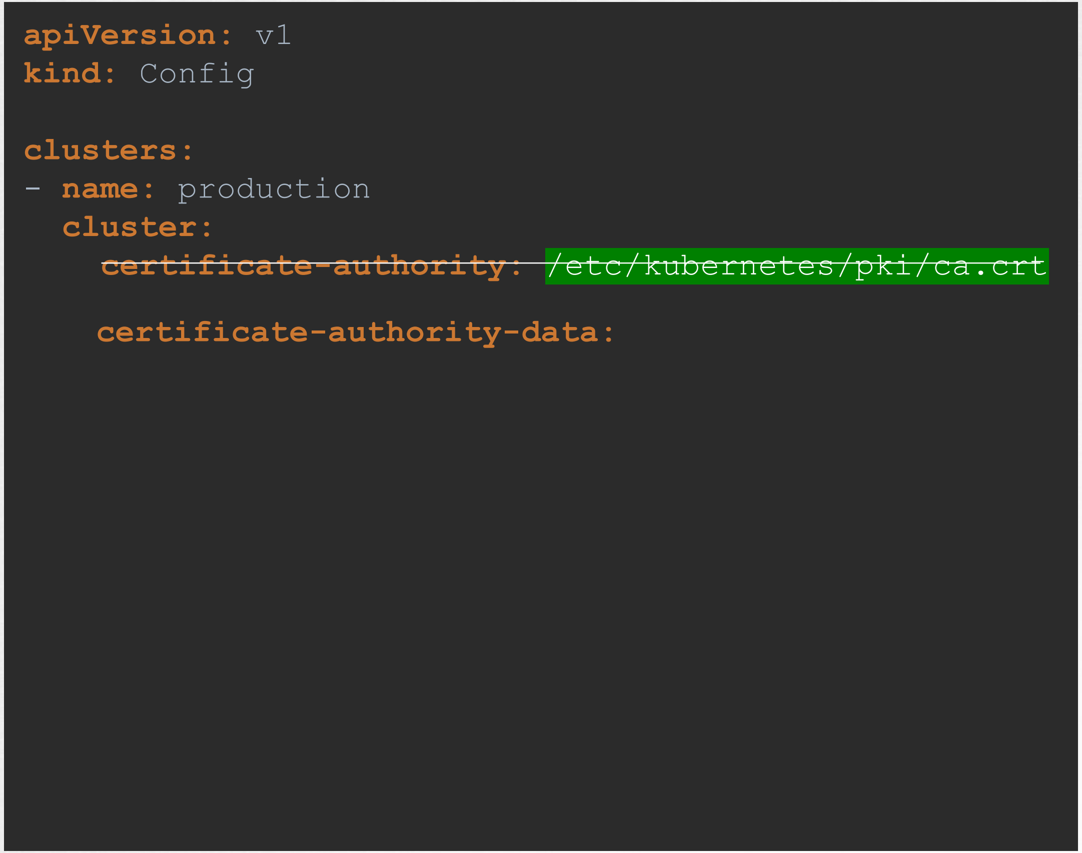
$HOME/.kube/config



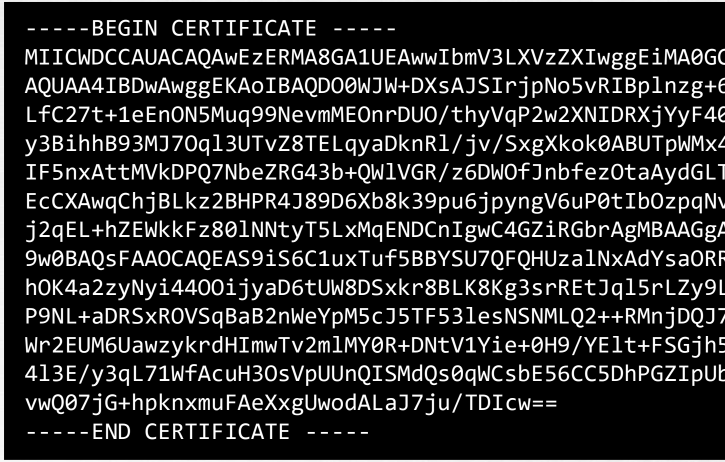
Certificates in KubeConfig

```yaml
apiVersion: v1
kind: Config

clusters:
- name: production
  cluster:
    certificate-authority: /etc/kubernetes/pki/ca.crt
    server: https://172.17.0.51:6443

contexts:
- name: admin@production
  context:
    cluster: production
    user: admin
    namespace: finance

users:
- name: admin
  user:
    client-certificate: /etc/kubernetes/pki/users/admin.crt
    client-key: /etc/kubernetes/pki/users/admin.key
```

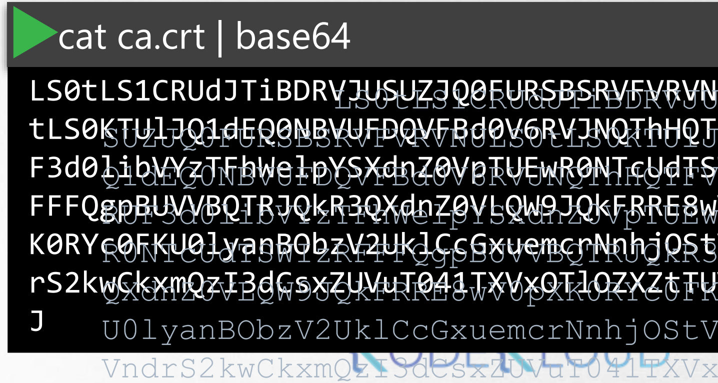
Certificates in KubeConfig



```
apiVersion: v1
kind: Config

clusters:
- name: production
  cluster:
    ~~certificate-authority: /etc/kubernetes/pki/ca.crt~~

    certificate-authority-data:
```



```
-----BEGIN CERTIFICATE -----
MIICWDCCAUACAQAwEzERMA8GA1UEAwwIbmV3LXVzZXIwggEiMA0GC
AQUAA4IBDwAwggEKAoIBAQDO0WJW+DXsAJSIrjpNo5vRIBplnzg+6
LfC27t+1eEnON5Muq99NevmMEOnrDUO/thyVqP2w2XNIDRXjYyF40
y3BihhB93MJ7Oql3UTvZ8TELqyaDknRl/jv/SxgXkok0ABUTpWMx4
IF5nxAttMVkDPQ7NbeZRG43b+QWlVGR/z6DWOfJnbfezOtaAydGLT
EcCXAwqChjBLkz2BHPR4J89D6Xb8k39pu6jpyngV6uP0tIbOzpqNv
j2qEL+hZEWkkFz80lNNtyT5LxMqENDCnIgwC4GZiRGbrAgMBAAGgA
9w0BAQsFAAOCAQEAS9iS6C1uxTuf5BBYSU7QFQHUzalNxAdYsaORR
hOK4a2zyNyi44OOijyaD6tUW8DSxkr8BLK8Kg3srREtJql5rLZy9L
P9NL+aDRSxROVSqBaB2nWeYpM5cJ5TF53lesNSNMLQ2++RMnjDQJ7
Wr2EUM6UawzykrdHImwTv2mlMY0R+DNtV1Yie+0H9/YElt+FSGjh5
4l3E/y3qL71WfAcuH3OsVpUUnQISMdQs0qWCsbE56CC5DhPGZIpUb
vwQ07jG+hpknxmuFAeXxgUwodALaJ7ju/TDIcw==
-----END CERTIFICATE -----
```



```
cat ca.crt | base64
```

```
LS0tLS1CRUdJTiBDRVJUSUZJQ0FURSBSRVFVRVN
tLS0KTUlJQ1dEQ0NBVUFDQVFBd0V6RVJNQThHQT
F3d0libVYzTFhWelpYSXdnZ0VpTUEwR0NTcUdTS
FFFQgpBUVVBQTRJQkR3QXdnZ0VLQW9JQkFRRE8w
K0RYc0FKU0lyanBOobzV2UklCcGxuemcrNnhjOSt
rS2kwCkxmQzI3dCsxZUVuT041TXVxOTlOZXZtTU
J
```

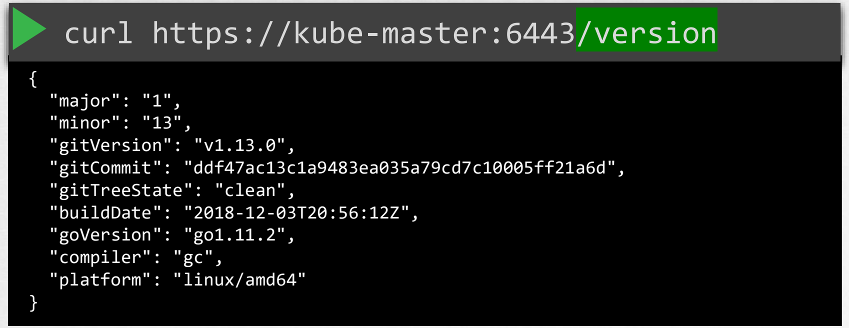
KODEKLOUD

Course Objectives

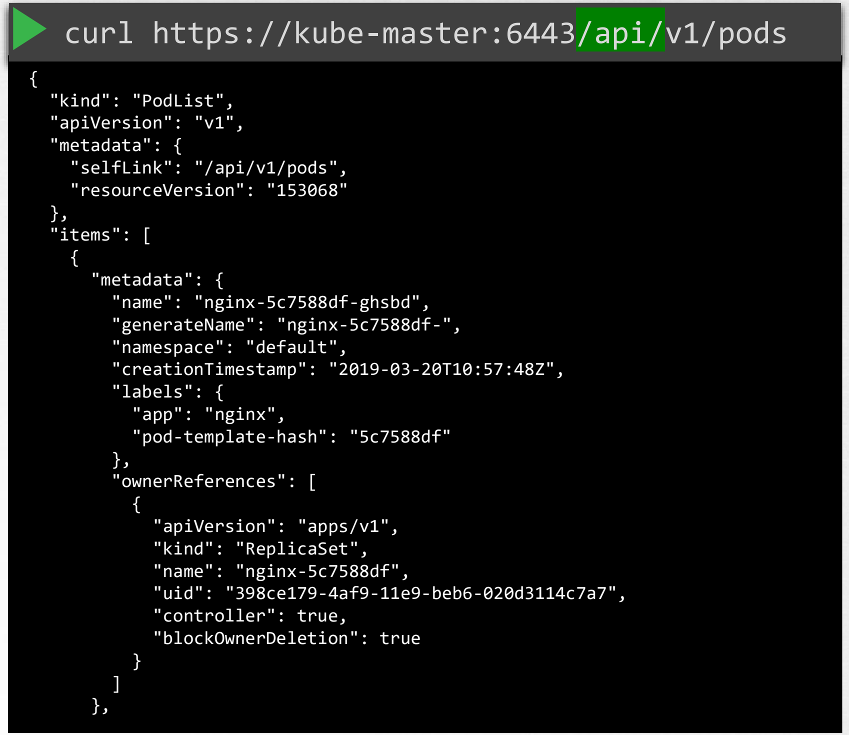
- Core Concepts
- Scheduling
- Logging Monitoring
- Application Lifecycle Management
- Cluster Maintenance
- Security
  - ○ Kubernetes Security Primitives
  - ○ Authentication
  - ○ TLS Certificates for Cluster Components
  - ○ Secure Persistent Key Value Store
  - Authorization
  - ○ Images Securely
  - ○ Security Contexts
  - ○ Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

API Groups

Pre-Requisite



```
▶ curl https://kube-master:6443/version
{
  "major": "1",
  "minor": "13",
  "gitVersion": "v1.13.0",
  "gitCommit": "ddf47ac13c1a9483ea035a79cd7c10005ff21a6d",
  "gitTreeState": "clean",
  "buildDate": "2018-12-03T20:56:12Z",
  "goVersion": "go1.11.2",
  "compiler": "gc",
  "platform": "linux/amd64"
}
```



```
▶ curl https://kube-master:6443/api/v1/pods
{
  "kind": "PodList",
  "apiVersion": "v1",
  "metadata": {
    "selfLink": "/api/v1/pods",
    "resourceVersion": "153068"
  },
  "items": [
    {
      "metadata": {
        "name": "nginx-5c7588df-ghsbd",
        "generateName": "nginx-5c7588df-",
        "namespace": "default",
        "creationTimestamp": "2019-03-20T10:57:48Z",
        "labels": {
          "app": "nginx",
          "pod-template-hash": "5c7588df"
        },
        "ownerReferences": [
          {
            "apiVersion": "apps/v1",
            "kind": "ReplicaSet",
            "name": "nginx-5c7588df",
            "uid": "398ce179-4af9-11e9-beb6-020d3114c7a7",
            "controller": true,
            "blockOwnerDeletion": true
          }
        ]
      },
```

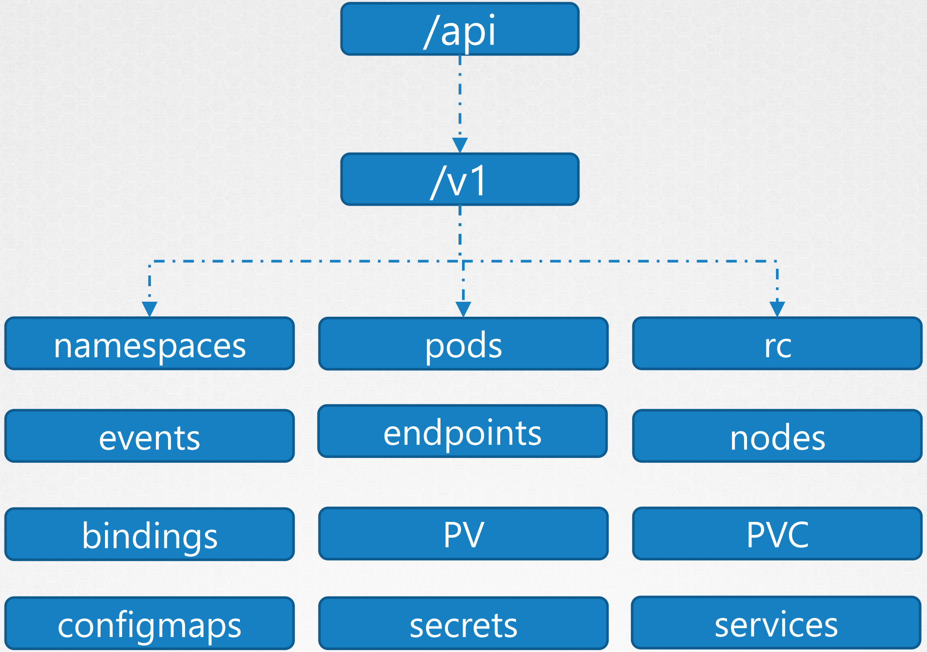
/metrics /healthz /version /api /apis /logs core

/api

named

/apis

core



/api

/v1

namespaces

pods

rc

events

endpoints

nodes

bindings

PV

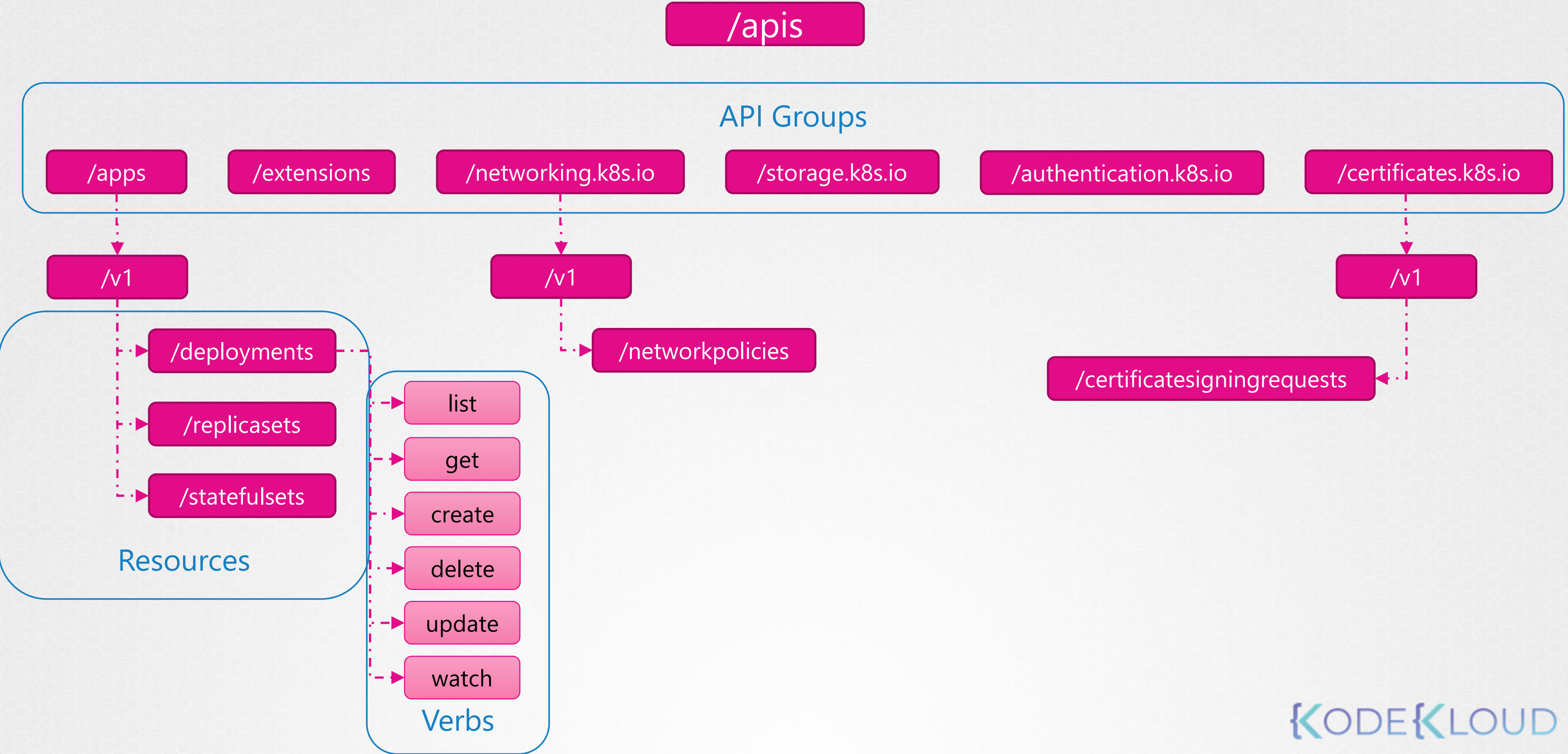
PVC

configmaps

secrets

services

named



/apis

API Groups

/apps

/extensions

/networking.k8s.io

/storage.k8s.io

/authentication.k8s.io

/certificates.k8s.io

/v1

/v1

/v1

/deployments

/replicasets

/statefulsets

Resources

/networkpolicies

/certificatesigningrequests

list

get

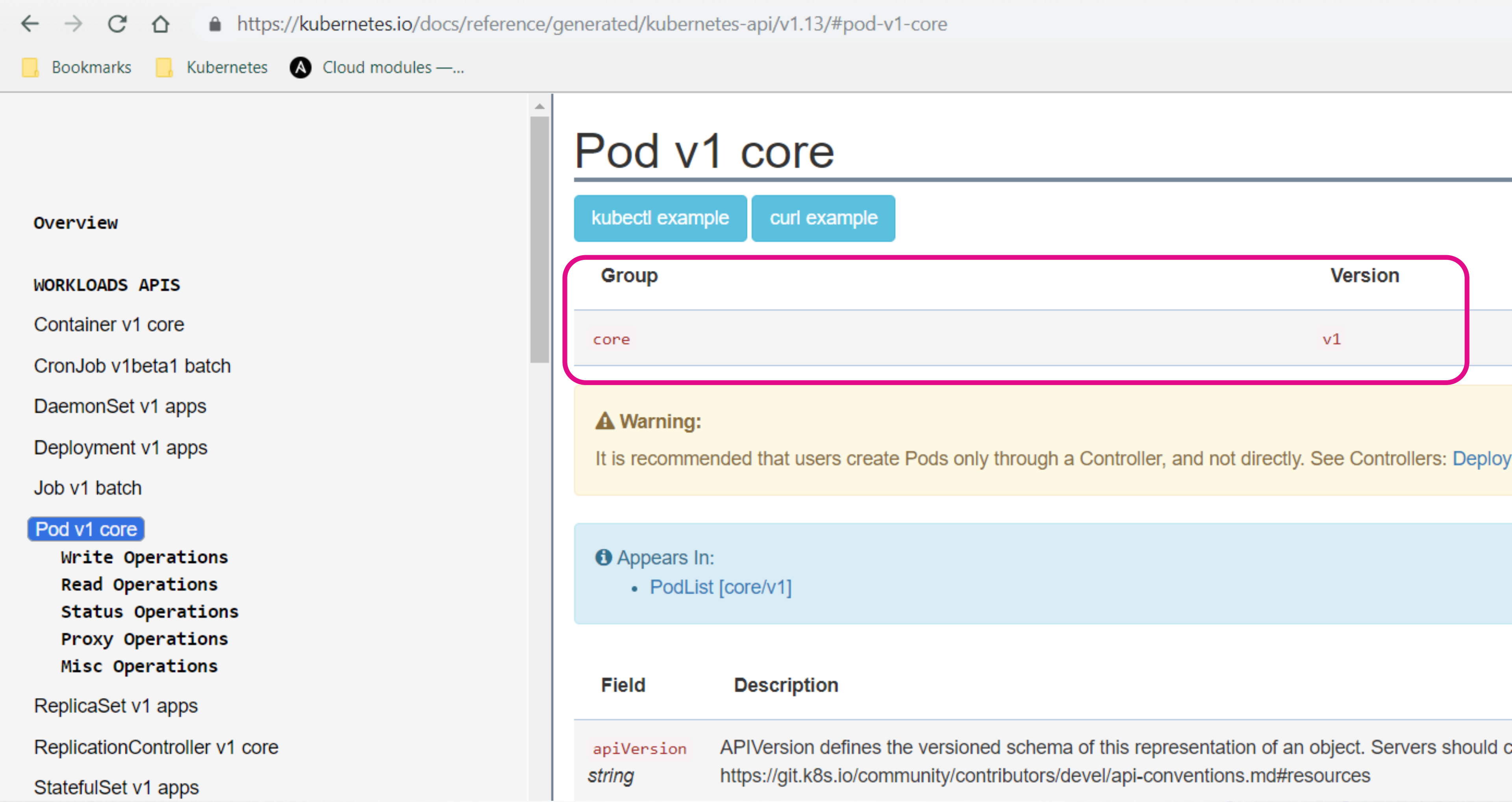
create

delete

update

watch

Verbs



Pod v1 core

Group	Version
`core`	`v1`

⚠ Warning:

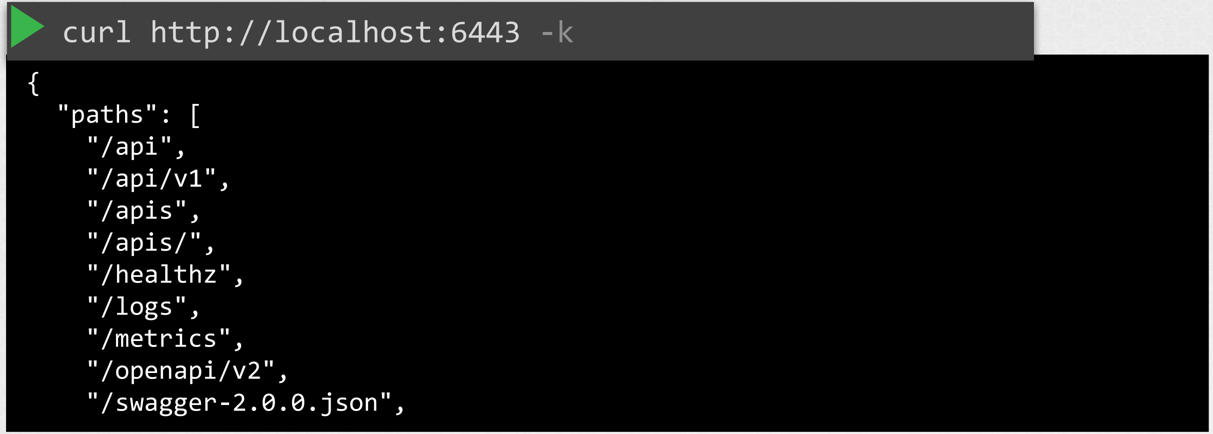
It is recommended that users create Pods only through a Controller, and not directly. See Controllers: Deploy

ℹ Appears In:

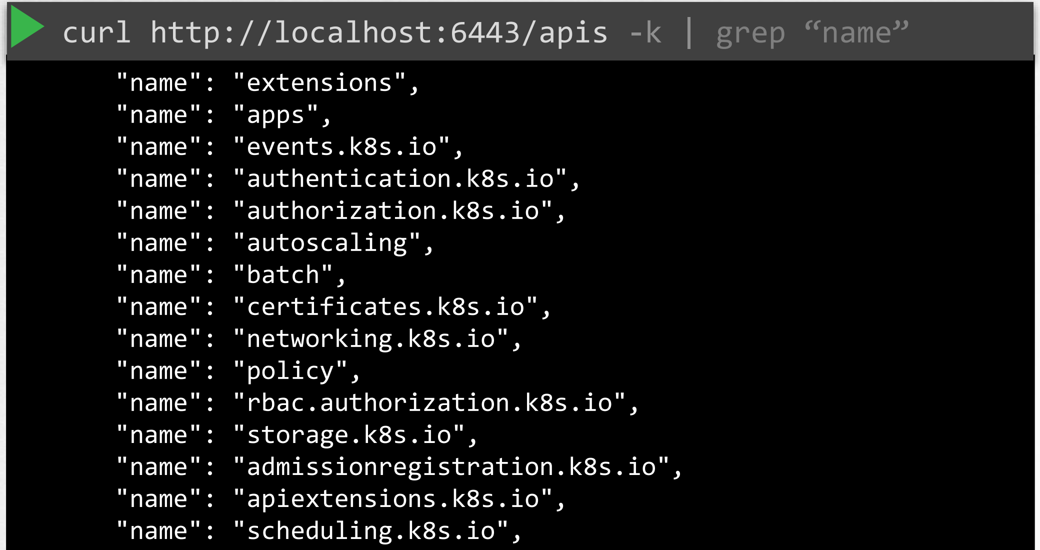
- PodList [core/v1]

Field	Description
`apiVersion` *string*	APIVersion defines the versioned schema of this representation of an object. Servers should c https://git.k8s.io/community/contributors/devel/api-conventions.md#resources

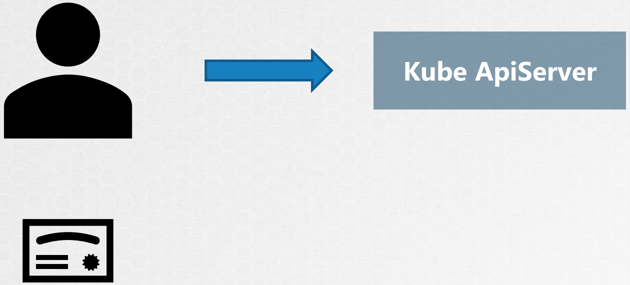
https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.13

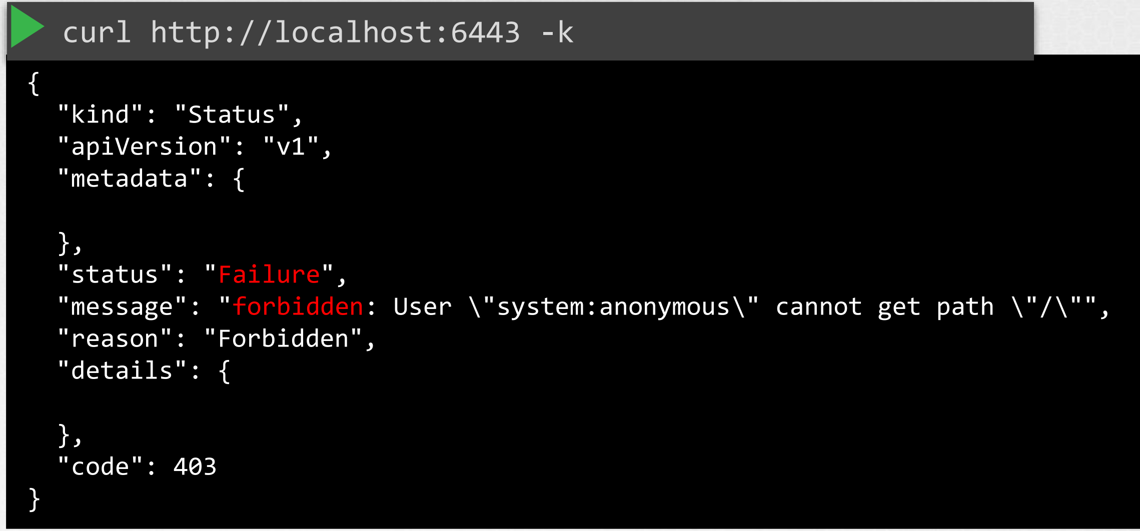


```
▶ curl http://localhost:6443 -k
{
  "paths": [
    "/api",
    "/api/v1",
    "/apis",
    "/apis/",
    "/healthz",
    "/logs",
    "/metrics",
    "/openapi/v2",
    "/swagger-2.0.0.json",
```



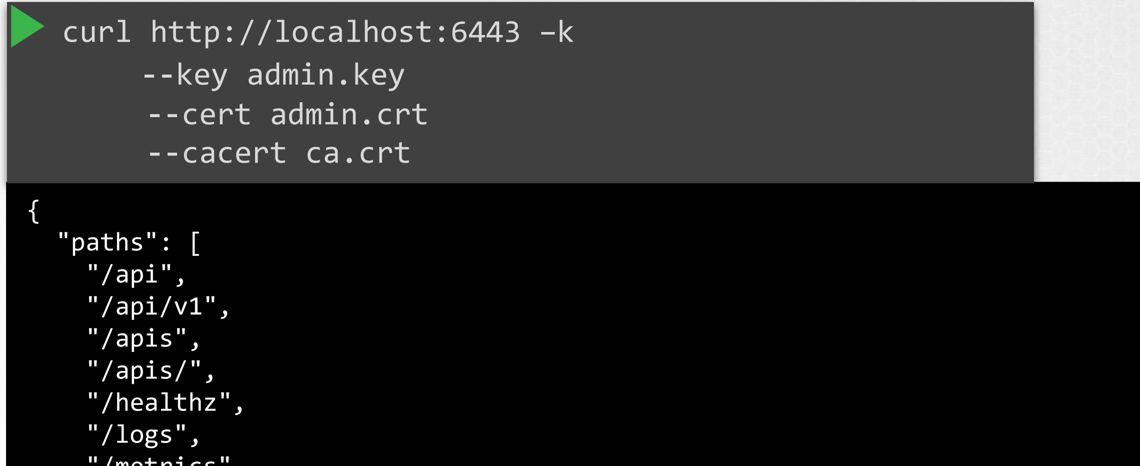
```
▶ curl http://localhost:6443/apis -k | grep “name”
      "name": "extensions",
      "name": "apps",
      "name": "events.k8s.io",
      "name": "authentication.k8s.io",
      "name": "authorization.k8s.io",
      "name": "autoscaling",
      "name": "batch",
      "name": "certificates.k8s.io",
      "name": "networking.k8s.io",
      "name": "policy",
      "name": "rbac.authorization.k8s.io",
      "name": "storage.k8s.io",
      "name": "admissionregistration.k8s.io",
      "name": "apiextensions.k8s.io",
      "name": "scheduling.k8s.io",
```





```
curl http://localhost:6443 -k
```

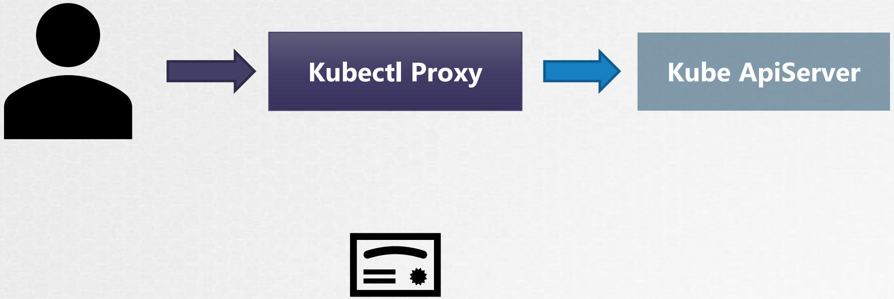
```
{
  "kind": "Status",
  "apiVersion": "v1",
  "metadata": {

  },
  "status": "Failure",
  "message": "forbidden: User \"system:anonymous\" cannot get path \"/\"",
  "reason": "Forbidden",
  "details": {

  },
  "code": 403
}
```

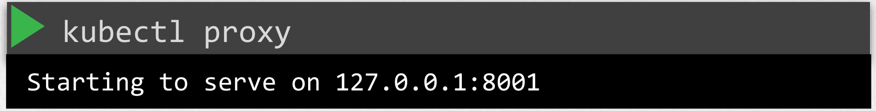


```
curl http://localhost:6443 -k
     --key admin.key
     --cert admin.crt
     --cacert ca.crt
```

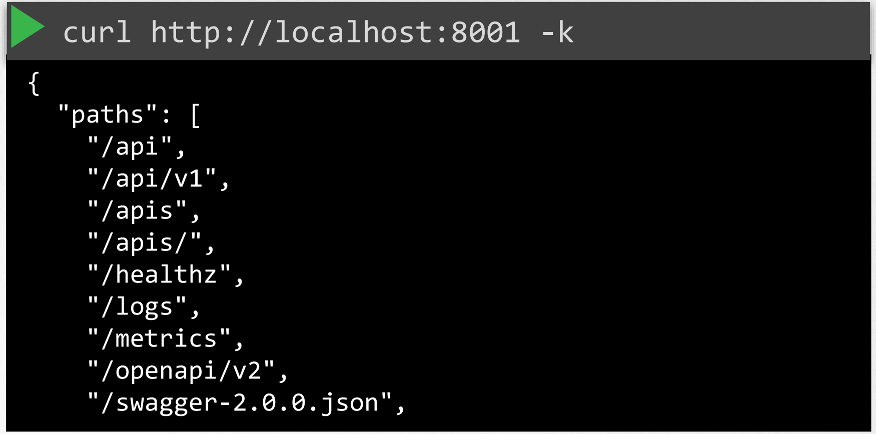
```
{
  "paths": [
    "/api",
    "/api/v1",
    "/apis",
    "/apis/",
    "/healthz",
    "/logs",
    "/metrics"
```

kubectl proxy





```
▶ kubectl proxy
Starting to serve on 127.0.0.1:8001
```

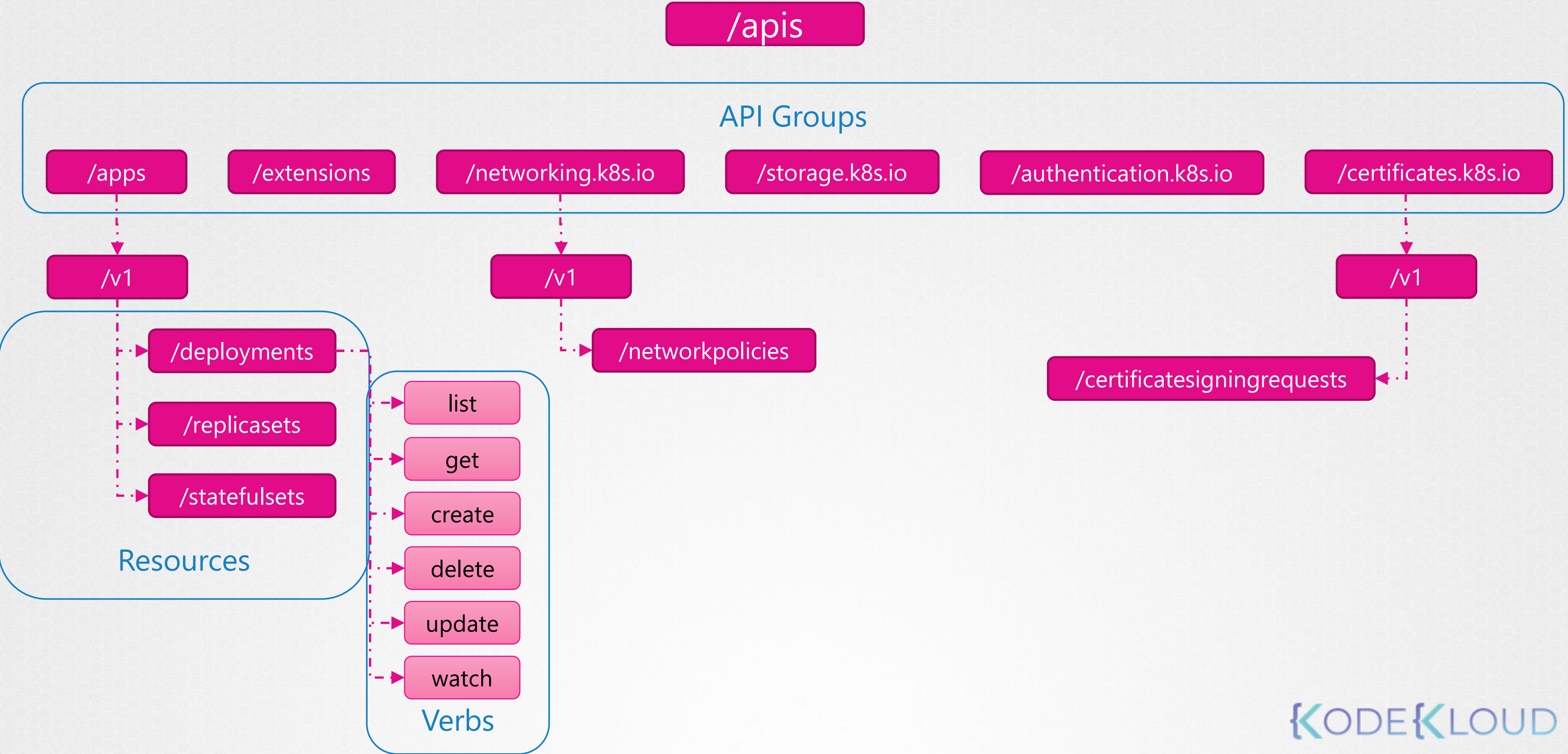


```
▶ curl http://localhost:8001 -k
{
  "paths": [
    "/api",
    "/api/v1",
    "/apis",
    "/apis/",
    "/healthz",
    "/logs",
    "/metrics",
    "/openapi/v2",
    "/swagger-2.0.0.json",
```

Kube proxy ≠ Kubectl proxy

Key Takeaways

named



KODEKLOUD

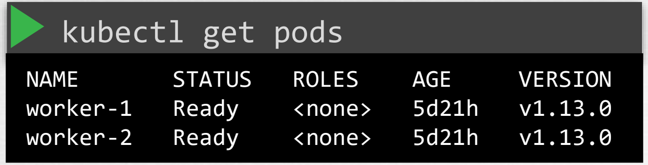
Course Objectives

- ● Core Concepts
- ● Scheduling
- ● Logging Monitoring
- ● Application Lifecycle Management
- ● Cluster Maintenance
- ● Security
  - ○ Kubernetes Security Primitives
  - ○ Authentication
  - ○ TLS Certificates for Cluster Components
  - ○ Secure Persistent Key Value Store
  - ○ Authorization
  - ○ Images Securely
  - ○ Security Contexts
  - ○ Network Policies
- ● Storage
- ● Networking
- ● Installation, Configuration & Validation
- ● Troubleshooting

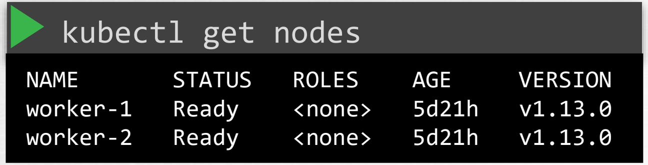
AUTHORIZATION

Why Authorization?

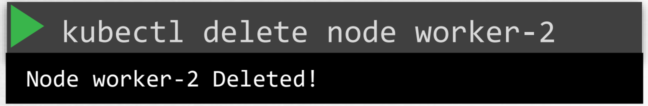
Admins



```
kubectl get pods
NAME       STATUS   ROLES    AGE     VERSION
worker-1   Ready    <none>   5d21h   v1.13.0
worker-2   Ready    <none>   5d21h   v1.13.0
```

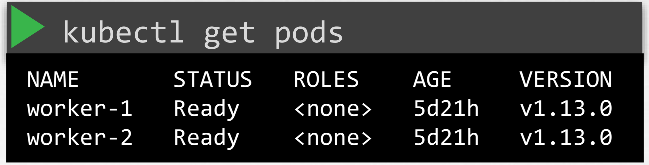


```
kubectl get nodes
NAME       STATUS   ROLES    AGE     VERSION
worker-1   Ready    <none>   5d21h   v1.13.0
worker-2   Ready    <none>   5d21h   v1.13.0
```

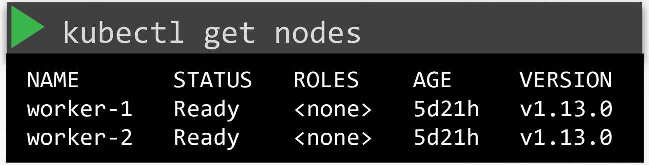


```
kubectl delete node worker-2
Node worker-2 Deleted!
```

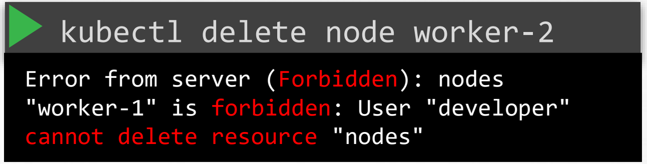
Developers



```
kubectl get pods
NAME       STATUS   ROLES    AGE     VERSION
worker-1   Ready    <none>   5d21h   v1.13.0
worker-2   Ready    <none>   5d21h   v1.13.0
```

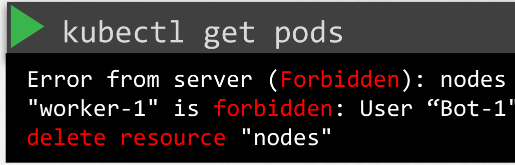


```
kubectl get nodes
NAME       STATUS   ROLES    AGE     VERSION
worker-1   Ready    <none>   5d21h   v1.13.0
worker-2   Ready    <none>   5d21h   v1.13.0
```

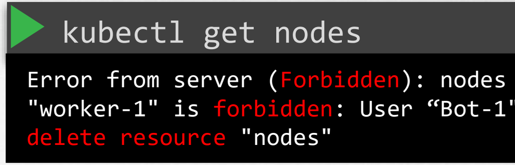


```
kubectl delete node worker-2
Error from server (Forbidden): nodes
"worker-1" is forbidden: User "developer"
cannot delete resource "nodes"
```

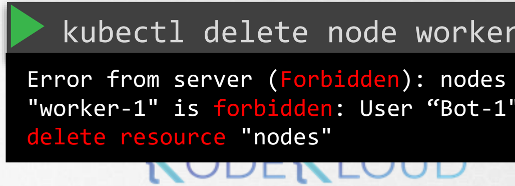
Bots



```
kubectl get pods
Error from server (Forbidden): nodes
"worker-1" is forbidden: User “Bot-1
delete resource "nodes"
```



```
kubectl get nodes
Error from server (Forbidden): nodes
"worker-1" is forbidden: User “Bot-1
delete resource "nodes"
```



```
kubectl delete node worker
Error from server (Forbidden): nodes
"worker-1" is forbidden: User “Bot-1
delete resource "nodes"
```

Authorization Mechanisms

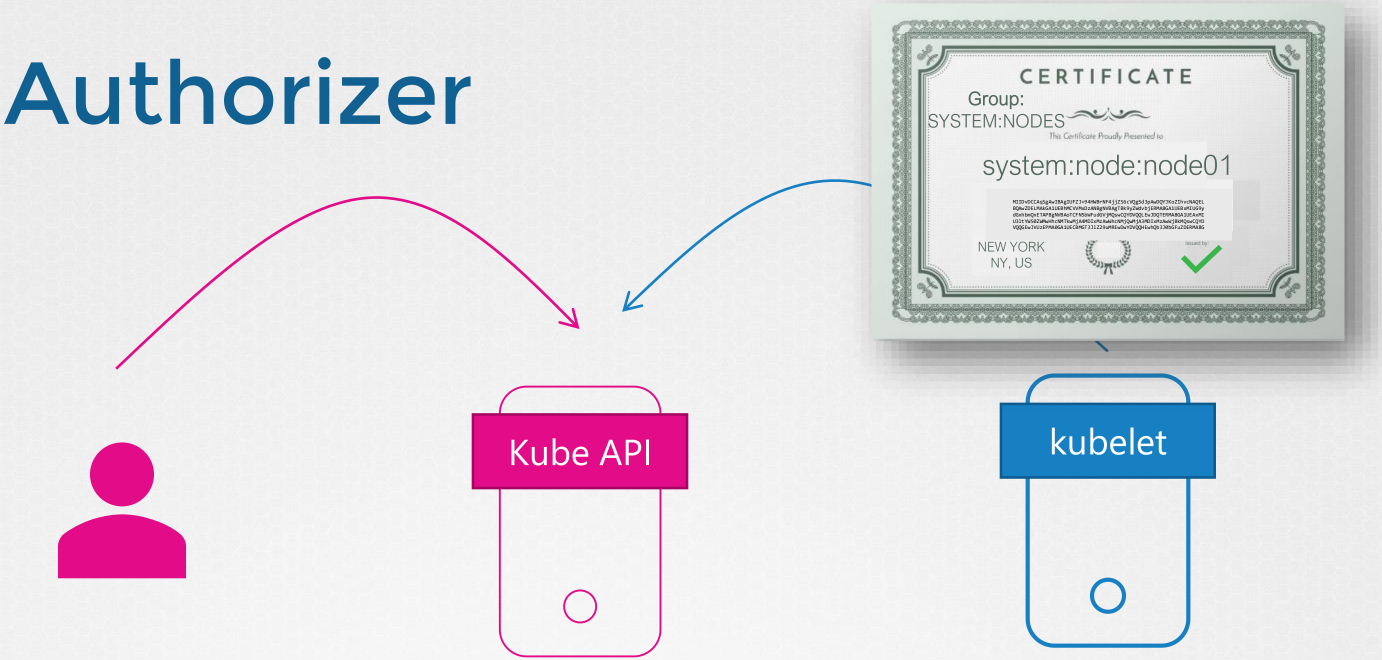
Node

ABAC

RBAC

Webhook

Node Authorizer



CERTIFICATE

Group:
SYSTEM:NODES

This Certificate Proudly Presented to

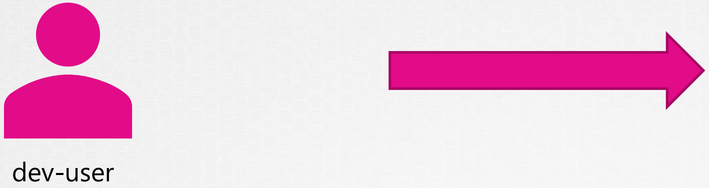
system:node:node01

NEW YORK
NY, US

Issued by:

- Read
  - Services
  - Endpoints
  - Nodes
  - Pods
- Write
  - Node status
  - Pod status
  - events

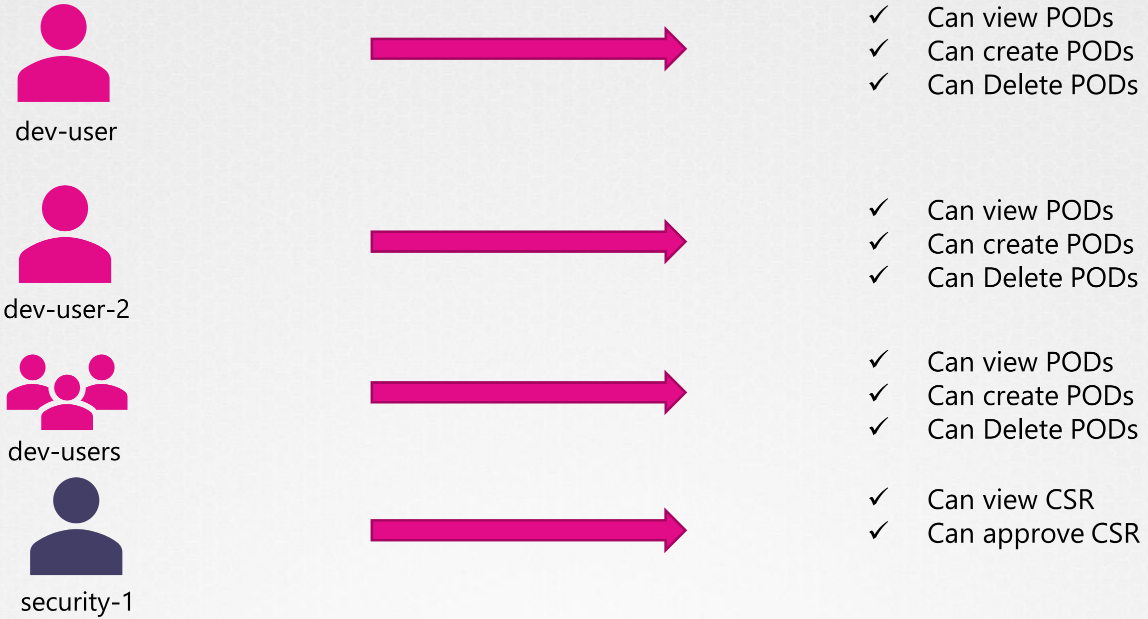
ABAC



- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs

```
{"kind": "Policy", "spec": {"user": “dev-user", "namespace": "*", "resource": “pods", "apiGroup": "*"}}
```

ABAC



dev-user

- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs

dev-user-2

- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs

dev-users

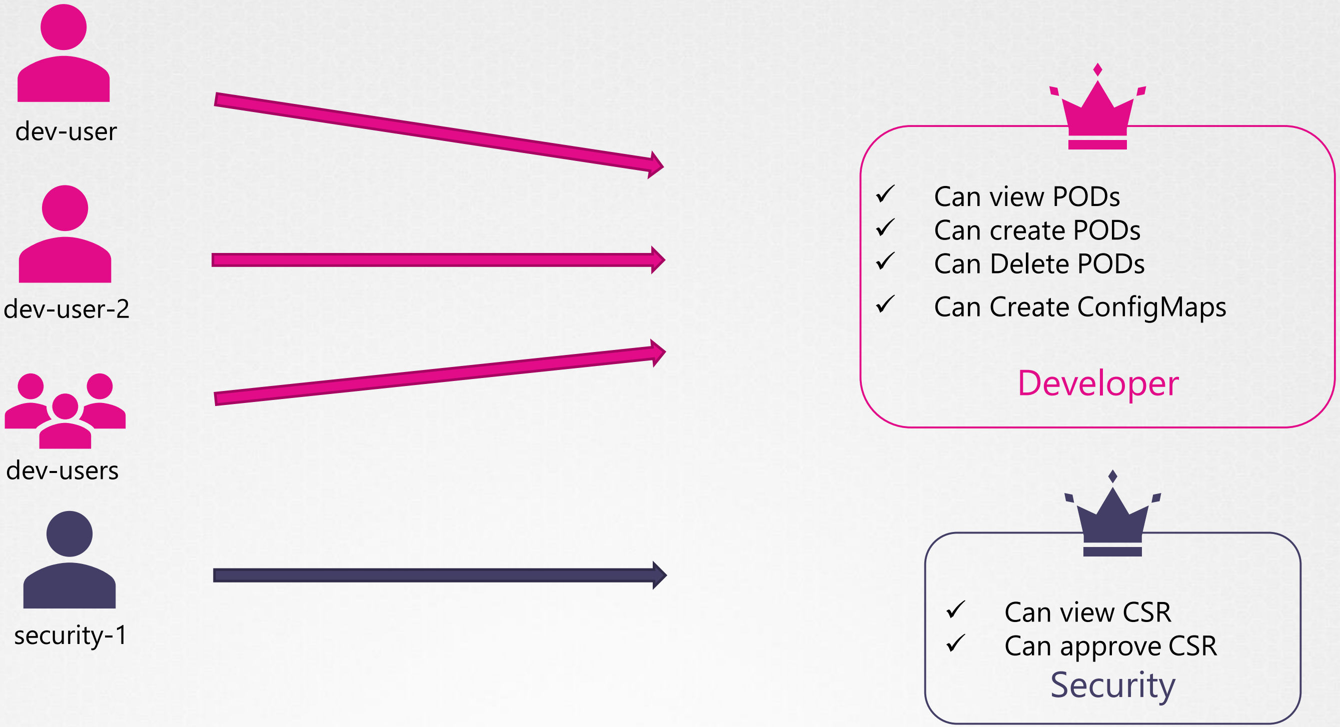
- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs

security-1

- ✓ Can view CSR
- ✓ Can approve CSR

```
{"kind": "Policy", "spec": {"user": “dev-user", "namespace": "*", "resource": “pods", "apiGroup": "*"}}
{"kind": "Policy", "spec": {"user": “dev-user-2", "namespace": "*", "resource": “pods", "apiGroup": "*"}}
{"kind": "Policy", "spec": {“group": “dev-users", "namespace": "*", "resource": “pods", "apiGroup": "*"}}
{"kind": "Policy", "spec": {"user": “security-1", "namespace": "*", "resource": “csr", "apiGroup": "*"}}
```

RBAC



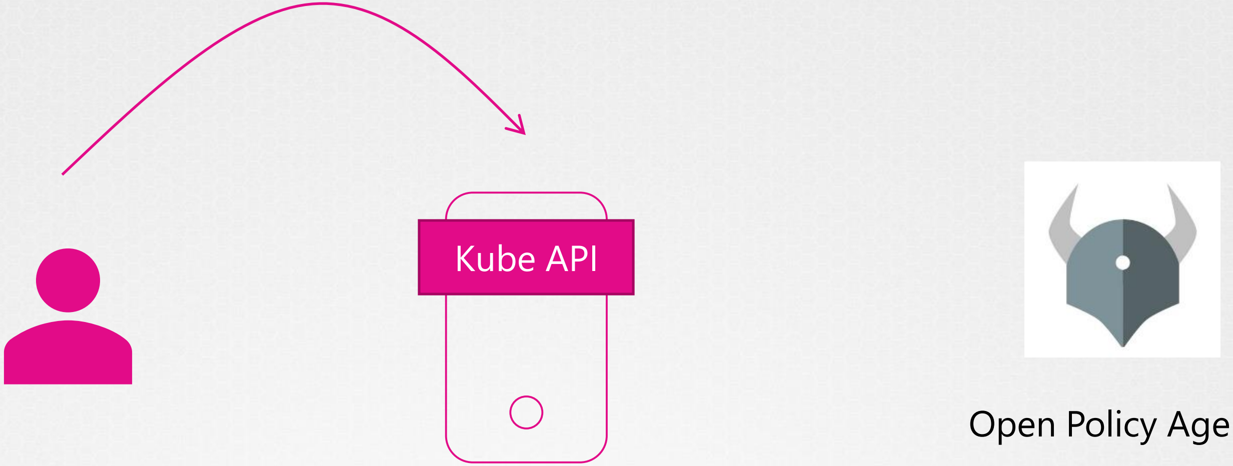
- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs
- ✓ Can Create ConfigMaps

Developer

- ✓ Can view CSR
- ✓ Can approve CSR

Security

Webhook



User **dev-user** requested read access to **Pods**. Should I allow?

I checked. Yes!

Authorization Mode

NODE

ABAC

RBAC

WEBHOOK

AlwaysAllow

AlwaysDeny

Authorization Mode

AlwaysAllow

NODE

ABAC

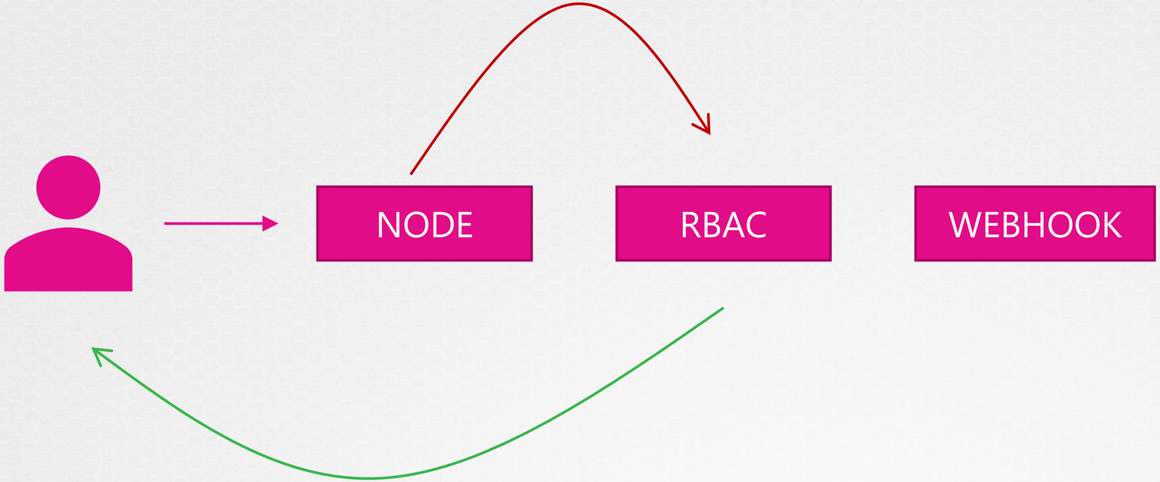
RBAC

WEBHOOK

AlwaysDeny

```
ExecStart=/usr/local/bin/kube-apiserver \\
  --advertise-address=${INTERNAL_IP} \\
  --allow-privileged=true \\
  --apiserver-count=3 \\
  --authorization-mode=Node,RBAC,Webhook \\
  --bind-address=0.0.0.0 \\
  --enable-swagger-ui=true \\
  --etcd-cafile=/var/lib/kubernetes/ca.pem \\
  --etcd-certfile=/var/lib/kubernetes/apiserver-etcd-client.crt \\
  --etcd-keyfile=/var/lib/kubernetes/apiserver-etcd-client.key \\
  --etcd-servers=https://127.0.0.1:2379 \\
  --event-ttl=1h \\
  --kubelet-certificate-authority=/var/lib/kubernetes/ca.pem \\
  --kubelet-client-certificate=/var/lib/kubernetes/apiserver-etcd-client.crt \\
  --kubelet-client-key=/var/lib/kubernetes/apiserver-etcd-client.key \\
  --service-node-port-range=30000-32767 \\
  --client-ca-file=/var/lib/kubernetes/ca.pem \\
  --tls-cert-file=/var/lib/kubernetes/apiserver.crt \\
  --tls-private-key-file=/var/lib/kubernetes/apiserver.key \\
  --v=2
```

Authorization Mode



```
ExecStart=/usr/local/bin/kube-apiserver \\
  --advertise-address=${INTERNAL_IP} \\
  --allow-privileged=true \\
  --apiserver-count=3 \\
  --authorization-mode=Node,RBAC,Webhook \\
  --bind-address=0.0.0.0 \\
```

KODEKLOUD

Course Objectives

- Core Concepts
- Scheduling
- Logging Monitoring
- Application Lifecycle Management
- Cluster Maintenance
- Security
  - Kubernetes Security Primitives
  - Authentication
  - TLS Certificates for Cluster Components
  - Secure Persistent Key Value Store
  - Authorization
  - Images Securely
  - Security Contexts
  - Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

RBAC

RBAC

- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs
- ✓ Can Create ConfigMaps

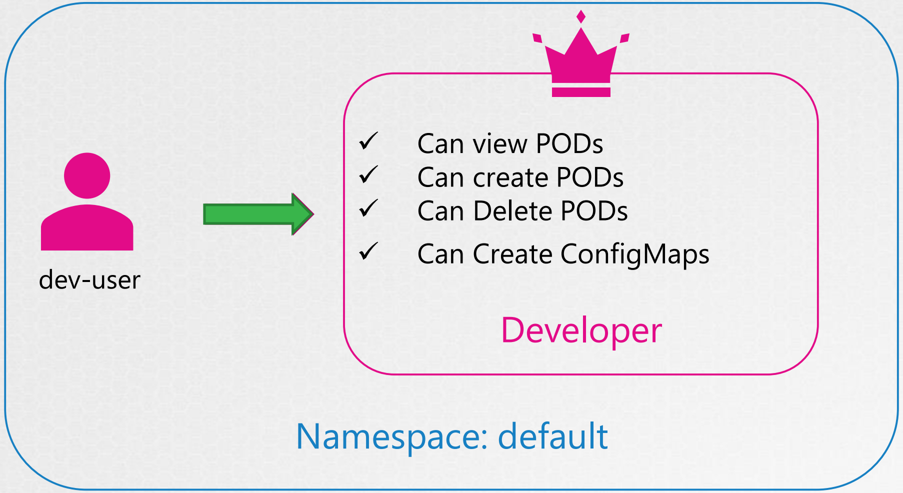
Developer

developer-role.yaml

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: developer
rules:
- apiGroups: [""]
  resources: ["pods"]
  verbs: ["list“, "get", “create“, “update“, “delete"]

- apiGroups: [""]
  resources: [“ConfigMap"]
  verbs: [“create“]
```

```
▶ kubectl create -f developer-role.yaml
```

RBAC



```
kubectl create -f devuser-developer-binding.yaml
```

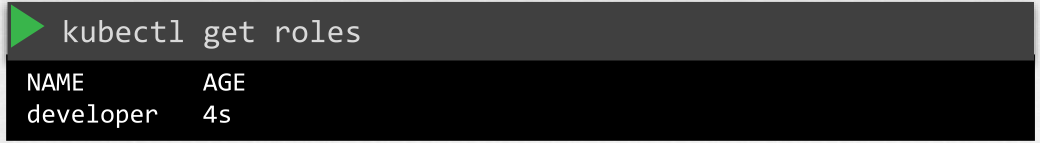
developer-role.yaml

```
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: developer
rules:
- apiGroups: [""]
  resources: ["pods"]
  verbs: ["list“, "get", “create“, “update“, “de
- apiGroups: [""]
  resources: [“ConfigMap"]
  verbs: [“create“]
```

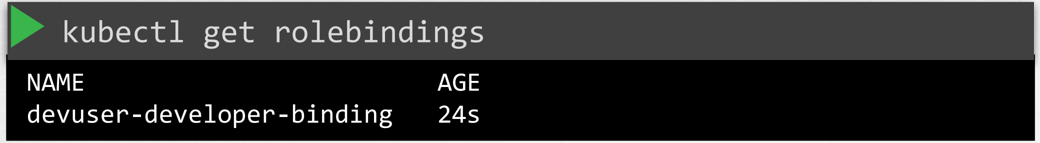
devuser-developer-binding.yaml

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: devuser-developer-binding
subjects:
- kind: User
  name: dev-user
  apiGroup: rbac.authorization.k8s.io
roleRef:
  kind: Role
  name: developer
  apiGroup: rbac.authorization.k8s.io
```

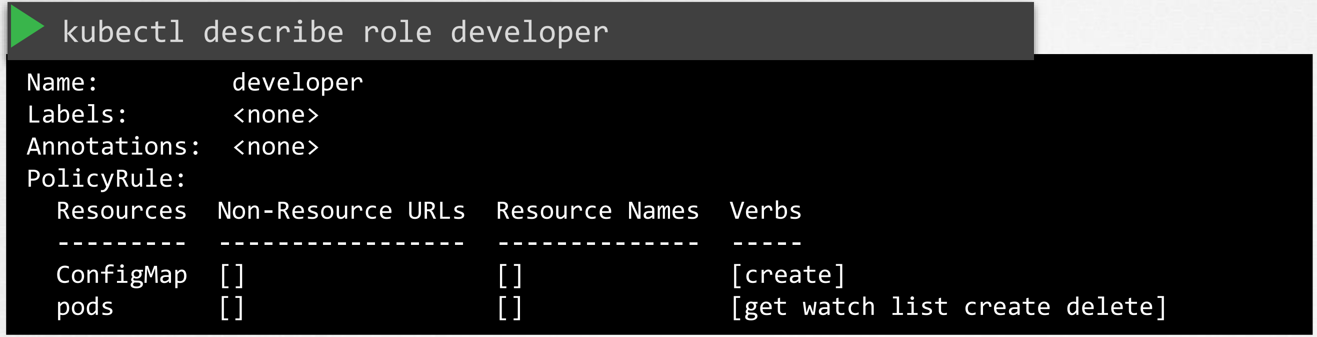
View RBAC



```
▶ kubectl get roles
NAME         AGE
developer    4s
```

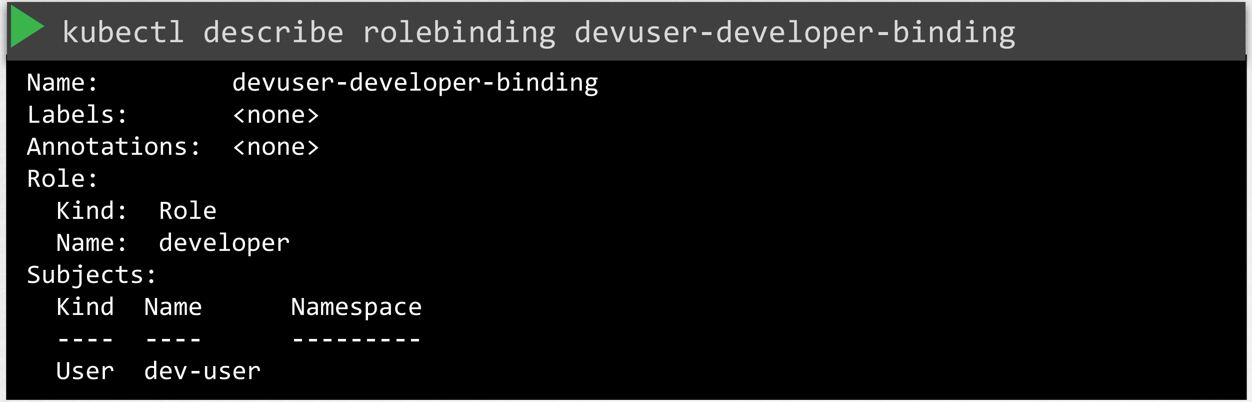


```
▶ kubectl get rolebindings
NAME                         AGE
devuser-developer-binding    24s
```



```
▶ kubectl describe role developer
Name:           developer
Labels:         <none>
Annotations:    <none>
PolicyRule:
  Resources   Non-Resource URLs  Resource Names  Verbs
  ---------   -----------------  --------------  -----
  ConfigMap   []                 []              [create]
  pods        []                 []              [get watch list create delete]
```

View RBAC



```
▶ kubectl describe rolebinding devuser-developer-binding
```

```
Name:          devuser-developer-binding
Labels:        <none>
Annotations:   <none>
Role:
  Kind:   Role
  Name:   developer
Subjects:
  Kind  Name      Namespace
  ----  ----      ---------
  User  dev-user
```

Check Access

```
▶ kubectl auth can-i create deployments
yes
```

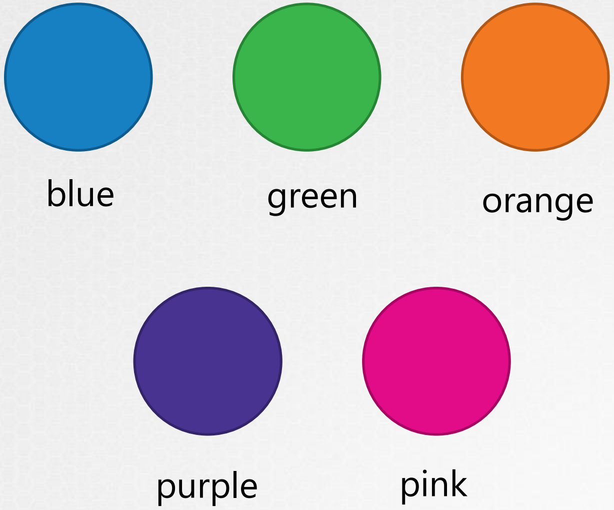
```
▶ kubectl auth can-i delete nodes
no
```

```
▶ kubectl auth can-i create deployments --as dev-user
no
```

```
▶ kubectl auth can-i create pods --as dev-user
yes
```

```
▶ kubectl auth can-i create pods --as dev-user --namespace test
no
```

Resource Names



developer-role.yaml

```
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: developer
rules:
- apiGroups: [""]
  resources: ["pods"]
  verbs: ["get", “create“, “update“]
  resourceNames: [“blue“, “orange”]
```

KODEKLOUD

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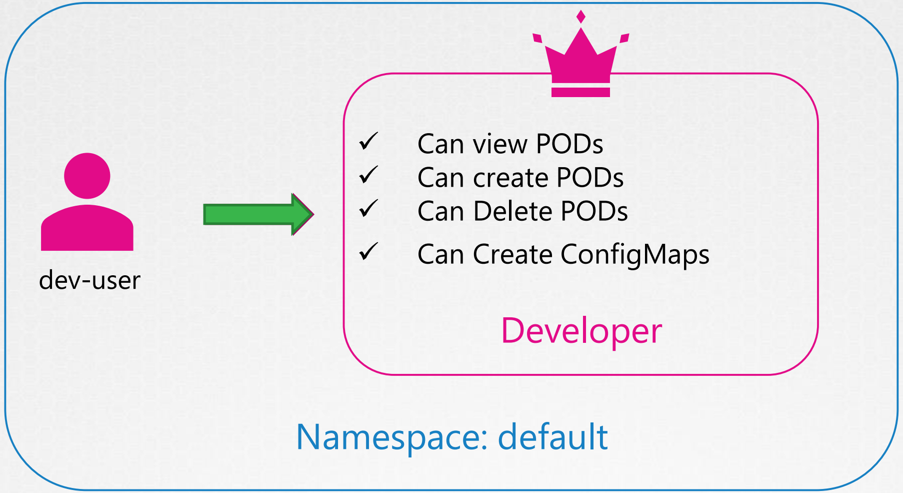
Cluster Roles

Roles



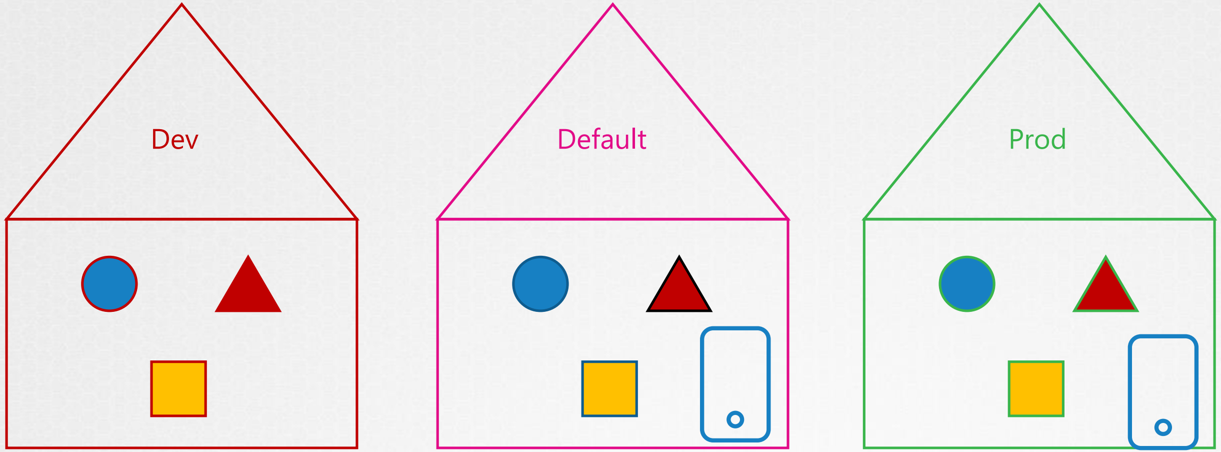
dev-user

- ✓ Can view PODs
- ✓ Can create PODs
- ✓ Can Delete PODs
- ✓ Can Create ConfigMaps

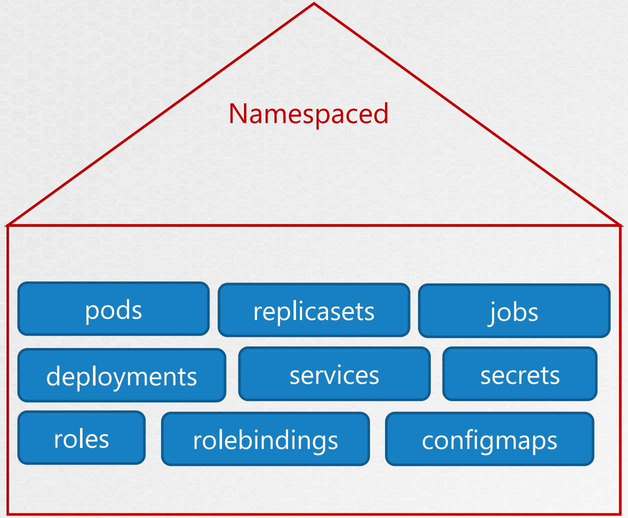
Developer

Namespace: default

Namespace



Namespace

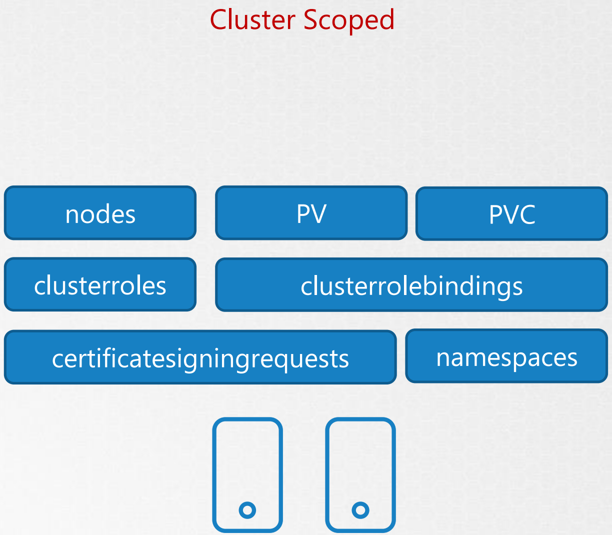


Namespaced

pods replicasets jobs

deployments services secrets

roles rolebindings configmaps



Cluster Scoped

nodes PV PVC

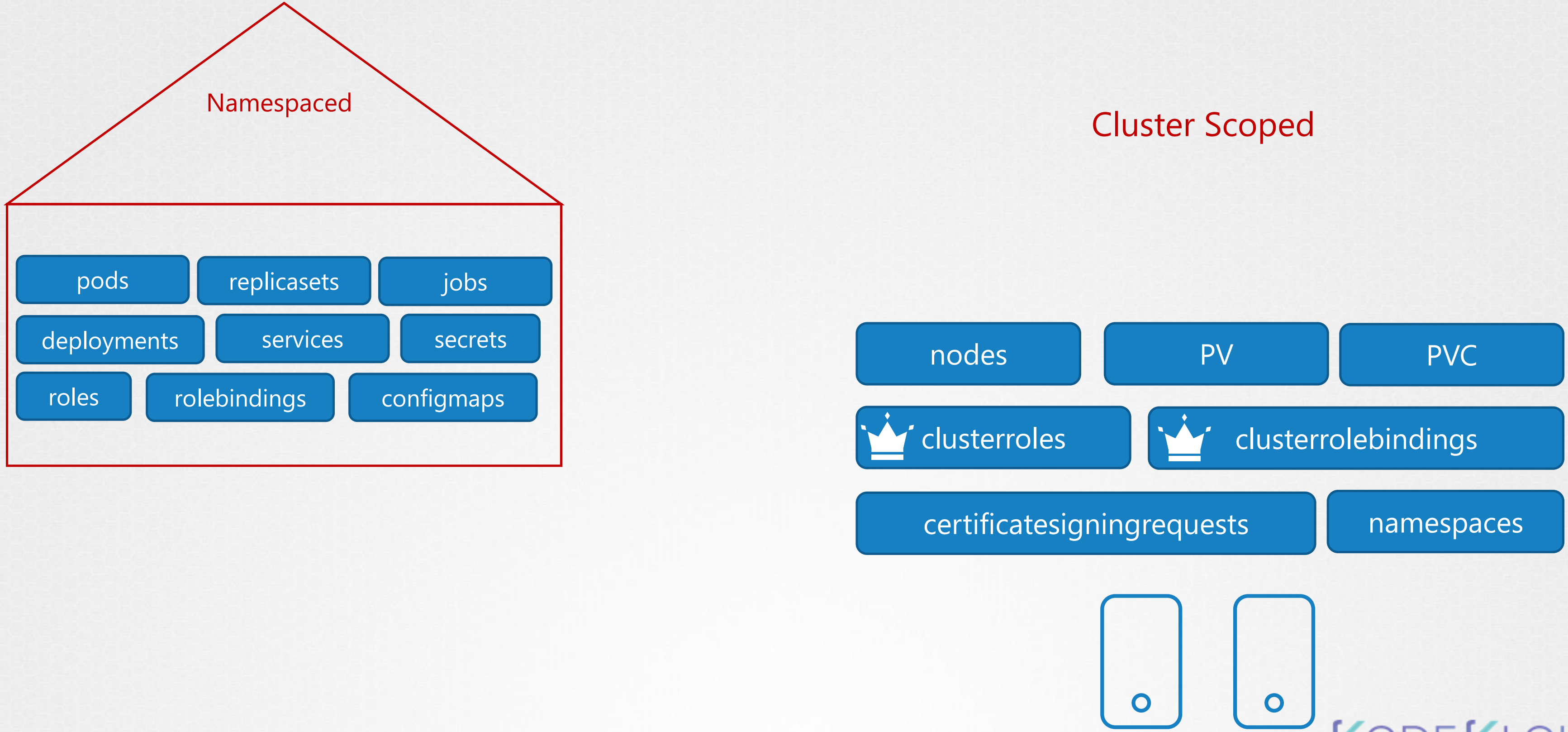
clusterroles clusterrolebindings

certificatesigningrequests namespaces

```
kubectl api-resources --namespaced=true
```

```
kubectl api-resources --namespaced=false
```

Namespace



Namespaced

pods

replicasets

jobs

deployments

services

secrets

roles

rolebindings

configmaps

Cluster Scoped

nodes

PV

PVC

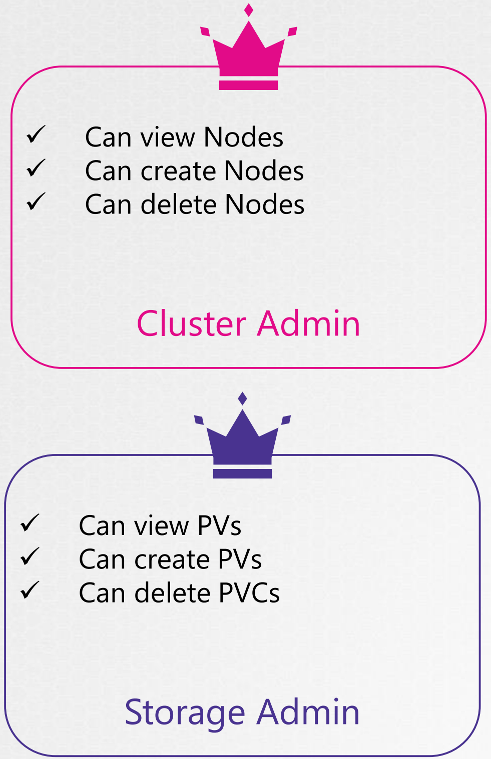
clusterroles

clusterrolebindings

certificatesigningrequests

namespaces

clusterroles



✓ Can view Nodes
✓ Can create Nodes
✓ Can delete Nodes

Cluster Admin

✓ Can view PVs
✓ Can create PVs
✓ Can delete PVCs

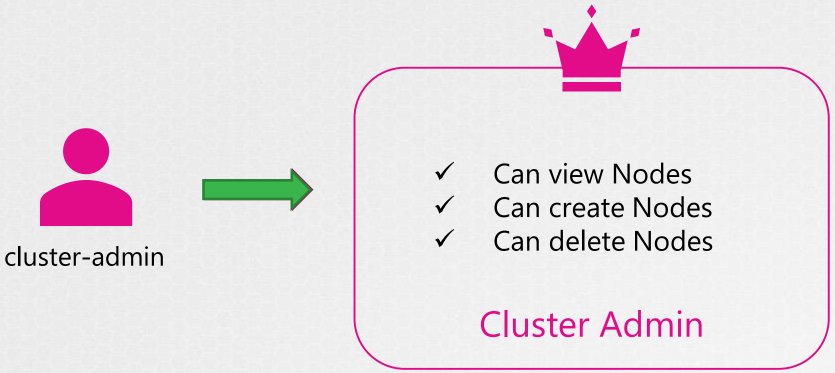
Storage Admin

cluster-admin-role.yaml

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: cluster-administrator
rules:
- apiGroups: [""]
  resources: [“nodes"]
  verbs: ["list“, "get", “create“, “delete"]
```

```
▶ kubectl create -f cluster-admin-role.yaml
```

clusterrolebinding



cluster-admin

- ✓ Can view Nodes
- ✓ Can create Nodes
- ✓ Can delete Nodes

Cluster Admin

cluster-admin-role.yaml

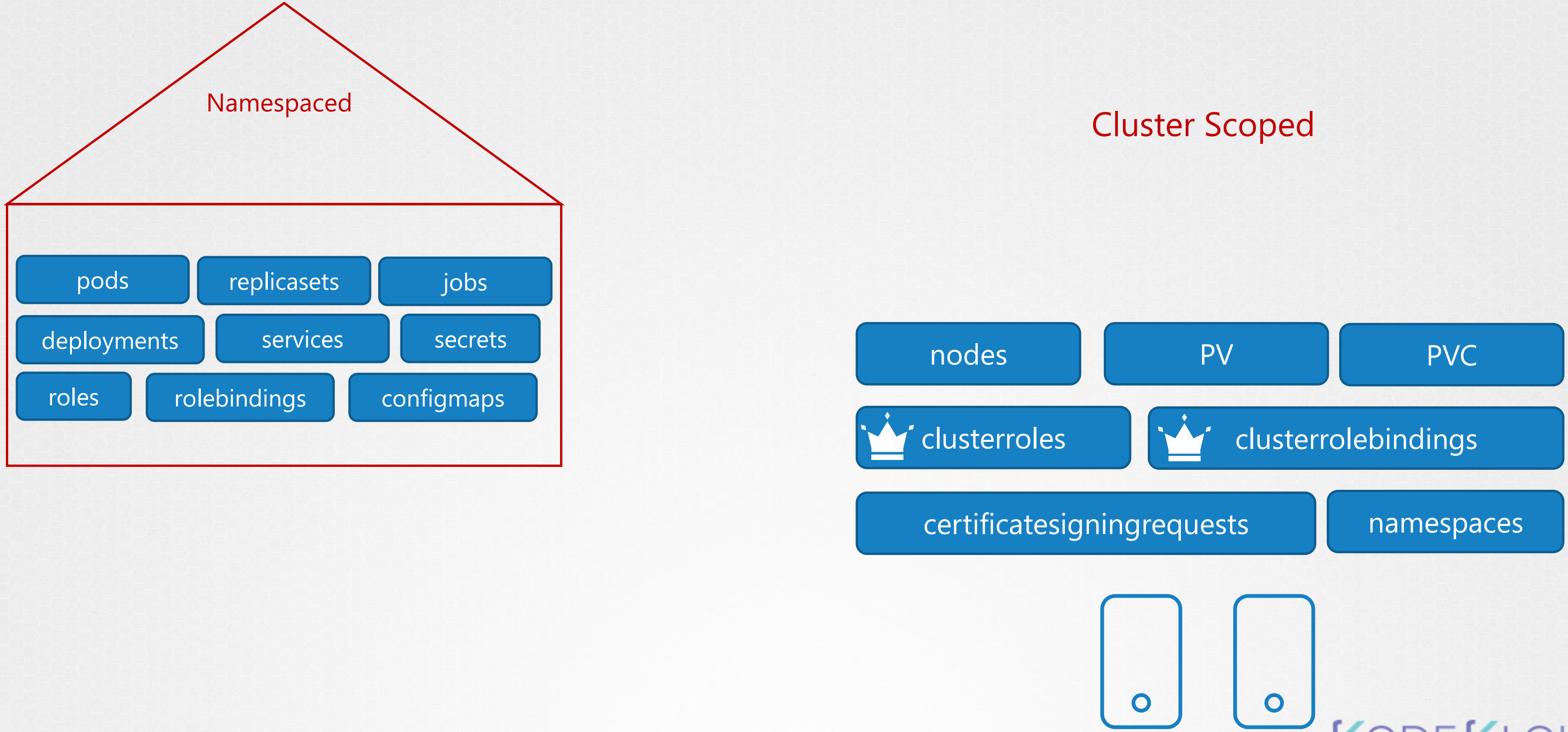
```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: cluster-administrator
rules:
- apiGroups: [""]
  resources: [“nodes"]
  verbs: ["list“, "get", “create“, “delete"]
```

cluster-admin-role-binding.yaml

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: cluster-admin-role-binding
subjects:
- kind: User
  name: cluster-admin
  apiGroup: rbac.authorization.k8s.io
roleRef:
  kind: ClusterRole
  name: cluster-administrator
  apiGroup: rbac.authorization.k8s.io
```

```
▶ kubectl create –f cluster-admin-role-binding.yaml
```

Cluster Roles



Namespaced

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namespaces

KODEKLOUD

Course Objectives

- Core Concepts
- Scheduling
- Logging Monitoring
- Application Lifecycle Management
- Cluster Maintenance
- Security
  - ○ Kubernetes Security Primitives
  - ○ Authentication
  - ○ TLS Certificates for Cluster Components
  - ○ Secure Persistent Key Value Store
  - ○ Authorization
  - ○ Images Securely
  - ○ Security Contexts
  - ○ Network Policies
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

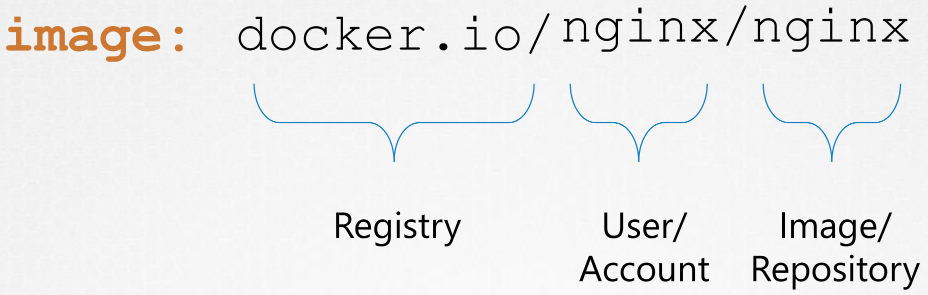
Image Security

Image

nginx-pod.yaml

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: nginx-pod
spec:
  containers:
  - name: nginx
    image: nginx
```

Image



```
image: docker.io/nginx/nginx
```

Registry

User/ Account

Image/ Repository

```
gcr.io/ kubernetes-e2e-test-images/dnsutils
```

Private Repository

```
▶ docker login private-registry.io
```

```
Login with your Docker ID to push and pull images from Docker Hub. If you don't have a Docker ID, head over to
https://hub.docker.com to create one.
Username: registry-user
Password:
WARNING! Your password will be stored unencrypted in /home/vagrant/.docker/config.json.

Login Succeeded
```

```
▶ docker run private-registry.io/apps/internal-app
```

Private Repository

```
docker login private-registry.io
```

```
docker run private-registry.io/apps/internal-app
```

```
kubectl create secret docker-registry regcred \
    --docker-server= private-registry.io     \
    --docker-username= registry-user  \
    --docker-password= registry-password  \
    --docker-email= registry-user@org.com
```

nginx-pod.yaml

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: nginx-pod
spec:
  containers:
  - name: nginx
    image:
  imagePullSecrets:
  - name: regcred
```